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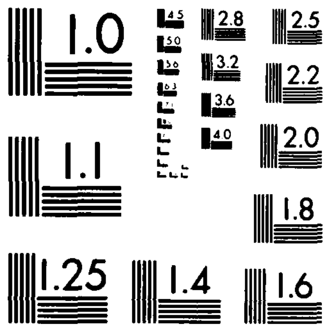

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TED STATES ARMED SERVICES AND OFFICE
? THE SECRETARY OF DEFENSE

ENLISTMENT EARLY WARNING SYSTEM AND ACCESSION CRISIS PREVENTION PROCESS

VOLUMES IV, V, VI AND VII

JUNE 15, 1984

ECONOMIC RESEARCH LABORATORY INC.

Advanced Technology

SRA CORPORATION

UNCLASSIFIED

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This study examines the feasibility of developing and implementing 1) an automated information system (EEWS) for providing timely, credible evidence of impending enlistments shortfalls, and 2) a streamlined communication, programming, and budgeting process (ACPP) for responding to such evidence and reducing delays in the application of resources.

A thorough review of existing early warning systems and forecasting methodologies was conducted (Vols. II and III). Using regression analysis with national-level monthly data (1/76-3/83), preliminary forecasting models for each Service were estimated for high-quality enlistment contracts. A univariate ARIMA forecasting model for unemployment was estimated with national-level monthly data (1/72-3/83). In beyond-sample validation tests for the period 4/83-12/83, the models accurately forecasted enlistments and unemployment nine months ahead; they predicted the declines in enlistments experienced by the Services in late 1983, well before the actual declines occurred (Vol.IV).

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ENLISTMENT EARLY WARNING SYSTEM
AND ACCESSION CRISIS PREVENTION PROCESS
PHASE I

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VOLUME VII	PHASE II IMPLEMENTATION PLAN Dr. Lawrence Goldberg, Dr. Richard Hunter, Gerald Yates,

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UNITED STATES ARMED SERVICES AND OFFICE
FOR THE SECRETARY OF DEFENSE

ENLISTMENT EARLY WARNING SYSTEM AND ACCESSION CRISIS PREVENTION PROCESS

VOLUME IV EEWS MODEL DEVELOPMENT

JUNE 15, 1984

ECONOMIC RESEARCH LABORATORY INC.

Advanced Technology

SRA CORPORATION

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION AND FEASIBILITY QUESTIONS

The purpose of this volume is to assess the feasibility of building the engine that would power the "warning" in the EEWS. Without productive analytical methodology and validated empirical models, the EEWS is inoperable. Major feasibility questions concern whether:

- Unexpected deviations in current enlistment trends can be detected promptly and reliably -- the monitoring function;

- Enlistments can be accurately forecast far enough into the future so that ameliorating responses can be effective;

- The information required as fuel for the engine, both public and Service-provided, can be made available in a timely manner.

The manner is which this volume addresses these questions can best be described by previewing the objectives and contents of the succeeding chapters.

By way of introduction to the description of model estimation and testing which dominates this volume, Chapter II presents several descriptive types of analysis applicable to an influx of enlistment data that would facilitate recognition of new patterns or trends. Specifically, time series decomposition and turning point methods are introduced. The intent is to develop, with these methods, an informative summary of enlistments trends as the first part of the monthly EEWS report.

Two broad classes of monthly models -- time series and regression -- have been identified, specified, and estimated in this study. Chapter III describes this work. Service-specific models have been developed for gross contract enlistment series; the focus is upon male high school diploma graduate and high school senior upper mental category cohorts; and the series

span the 1976-83 period. In building the monitoring function the major requirement is that the model(s) selected closely track enlistments. Accordingly, the emphasis is upon model fit (how much of the variation in enlistments is explained), the average size of the tracking error, and the associated confidence intervals within which current and next month's enlistments are expected to lie. The aim is to develop intervals that are sufficently tight (at reasonable levels of confidence) in order not to overlook situations in which a monitoring alert should be sounded.

Since unemployment is an important driver of enlistments and a major future unknown, the capability to accurately forecast unemployment rates is crucial. In Chapter IV univariate time-series and regression leading indicator models of unemployment are specified, estimated, and put to a forecasting test. In addition we discuss outside sources of unemployment forecasts that could be available to the EWS and compare their forecasting accuracy over the April to December 1983 period.

The creation of a validated modeling engine provides behavioral and statistical credibility to the EEWS. Constant use and experience will eventually provide a kind of operational validity. For the present, validity can be established with forecasting tests: Are models that appear to track well within the estimation period also capable of producing accurate forecasts beyond the estimation period? In Chapter V, model forecasts are tested over a nine month period beginning in April 1983 (the estimation period ends in March). The only future knowledge that is admitted concerns the number of recruiters, goals/missions, and civilian earnings (which are relatively stable anyway). Unemployment forecasts developed in the previous chapter are utilized in this exercise. The analysis focuses upon forecasting accuracy; patterns to the errors; the gains in accuracy of forecasting contracts when forecasting accuracy from knowing prior months applicant flows; and the detection of bellwether recruiting regions that may improve the tracking capability and push the forecasting window further out.

With a prototype monitoring and forecasting engine estimated and tested, we turn, in Chapter VI, to the larger EEWS which it serves, and examine the

conceptual framework within which it operates. A brief description of the three basic components is reiterated. The last chapter considers system feasibility questions, and presents a system feasibility illustration. It moves through the monitoring, forecasting, and alerting exercises as it would have on March 31, 1983 with only the amount of future knowledge described above. Given service goals/missions over the next nine months, the task is to evaluate the alerting functions. Would the forecasts and associated confidence intervals have led to alerts that the achieving of goal was in jeopardy? Would they have been correct or false alarms? The chapter concludes with an overall feasibility assessment.

Chapter II

DESCRIPTIVE ANALYSIS

In this chapter we discuss several types of analyses that facilitate the evaluation of current enlistment trends. Seasonality and cyclicality are primary characteristics of enlistments over time. To answer the question "are enlistments moving up, down, or staying the same?" one needs to abstract from seasonal variation and to perceive the length and shape of the current enlistment cycle. The purpose of the procedures described below is to isolate the seasonal influences and to develop descriptive indicators of impending turning points.

A. Decompostion of Enlistment Time Series

A common and useful practice is to view a time series as being composed of trend (T), cyclical (C), seasonal (S), and irregular (I), subpatterns. The seasonal component is defined as intra-year variation that is repeated constantly or in an evolving fashion from year to year. The trend-cycle component includes variation due to the long-term trend and the business cycle. The irregular component is residual variation. Once seasonal influences are removed, the remaining subpatterns become more apparent. Further, if irregular movements can be isolated (perhaps viewed as arbitrarily large changes), then the trend-cycle subpattern may emerge. Finally, by bringing auxiliary information into play, it may be possible to identify and remove the trend subpattern.

1. Decomposition Algorithm

The Bureau of the Census developed the decomposition algorithm that provides the basis for the SAS PROC X-11 computer program we have applied. Many economic time series are related in a multiplicative fashion, and we have found it reasonable to assume that enlistments (E) can be decomposed as follows:

(1) $E = T \times C \times S \times I$

A variation of the basic ratio-to-moving-average technique is utilized to isolate the seasonal subpattern. First, the trend-cycle component is approximated by calculating a centered 12 month moving average, and by dividing the original series (by this moving average) to obtain a preliminary estimate of the seasonal-irregular component:

(2) $$\frac{E}{T \times C} = \frac{T \times C \times S \times I}{T \times C} = S \times I$$

Second, a weighted moving average is applied to the S x I component to estimate the seasonal factors, and the two are divided to obtain a preliminary estimate of the irregular component. Third, a modified seasonal-irregular series is derived from an extreme value analysis of the irregular component. Fourth, new seasonal factors are estimated by repeating the second step (above) with the modified S x I series. Fifth, a preliminary seasonally adjusted time series results from dividing the original series by these seasonal factors:

(3) $$\frac{E}{S} = \frac{T \times C \times S \times I}{S} = T \times C \times I = \text{seasonally adjusted series}$$

Sixth, applying a weighted moving average to this seasonally adjusted series gives a second estimate of the trend-cycle curve. Finally, these same steps are repeated to obtain refined estimates of the seasonal factors, the seasonally-adjusted series, trend-cycle, and irregular components.

2. Seasonally-Adjusted Enlistments

Using PROC X-11, seasonal factors were estimated and applied to the enlistment series (gross contracts) to produce the seasonally-

G 1. CHART
(X) - D11. FINAL SEASONALLY ADJUSTED SERIES
(O) - D12. FINAL TREND CYCLE
(*) - COINCIDENCE OF POINTS
SCALE-SEMI-LOG ONE CYCLE

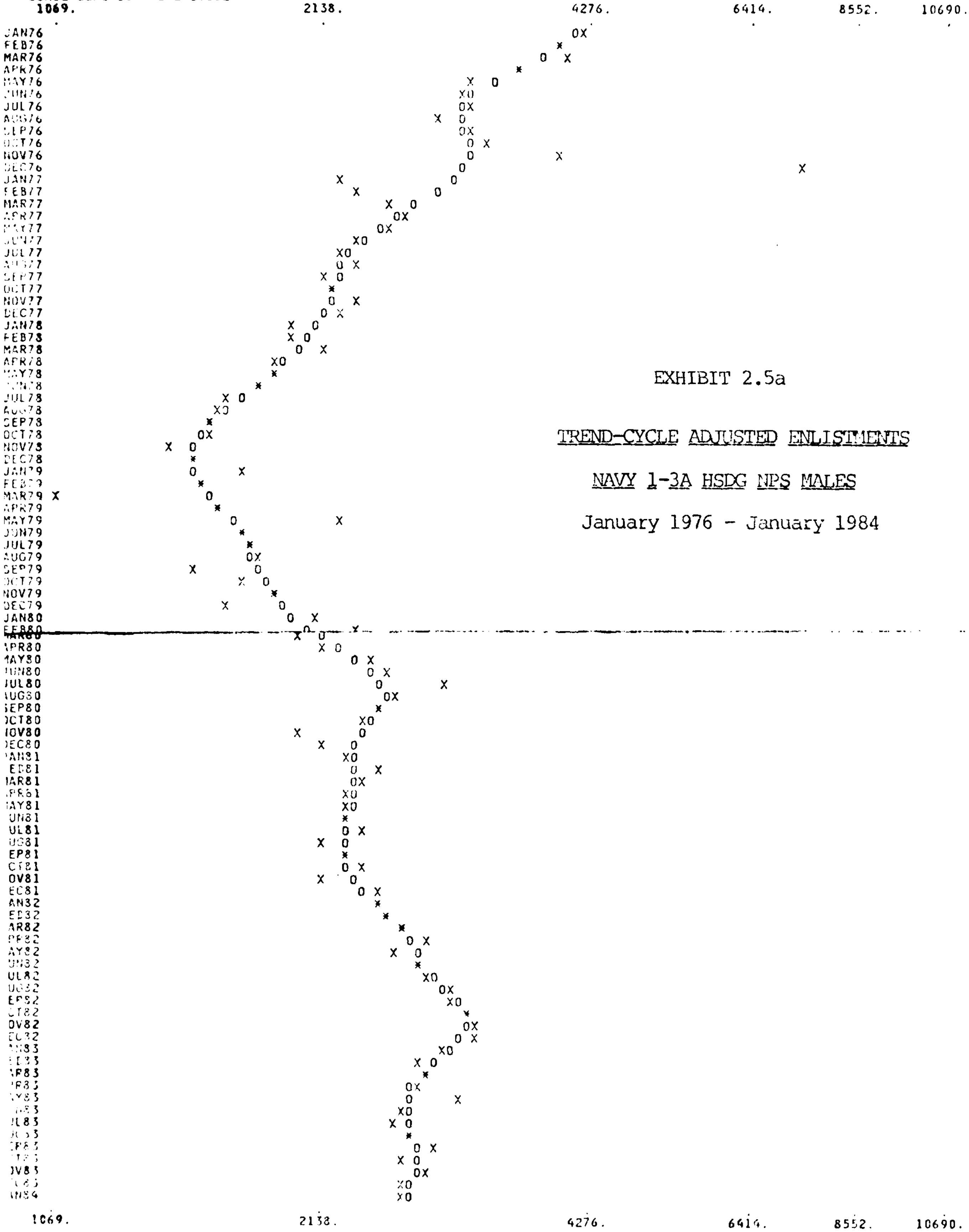

EXHIBIT 2.5a

TREND-CYCLE ADJUSTED ENLISTMENTS

NAVY 1-3A HSDG NPS MALES

January 1976 - January 1984

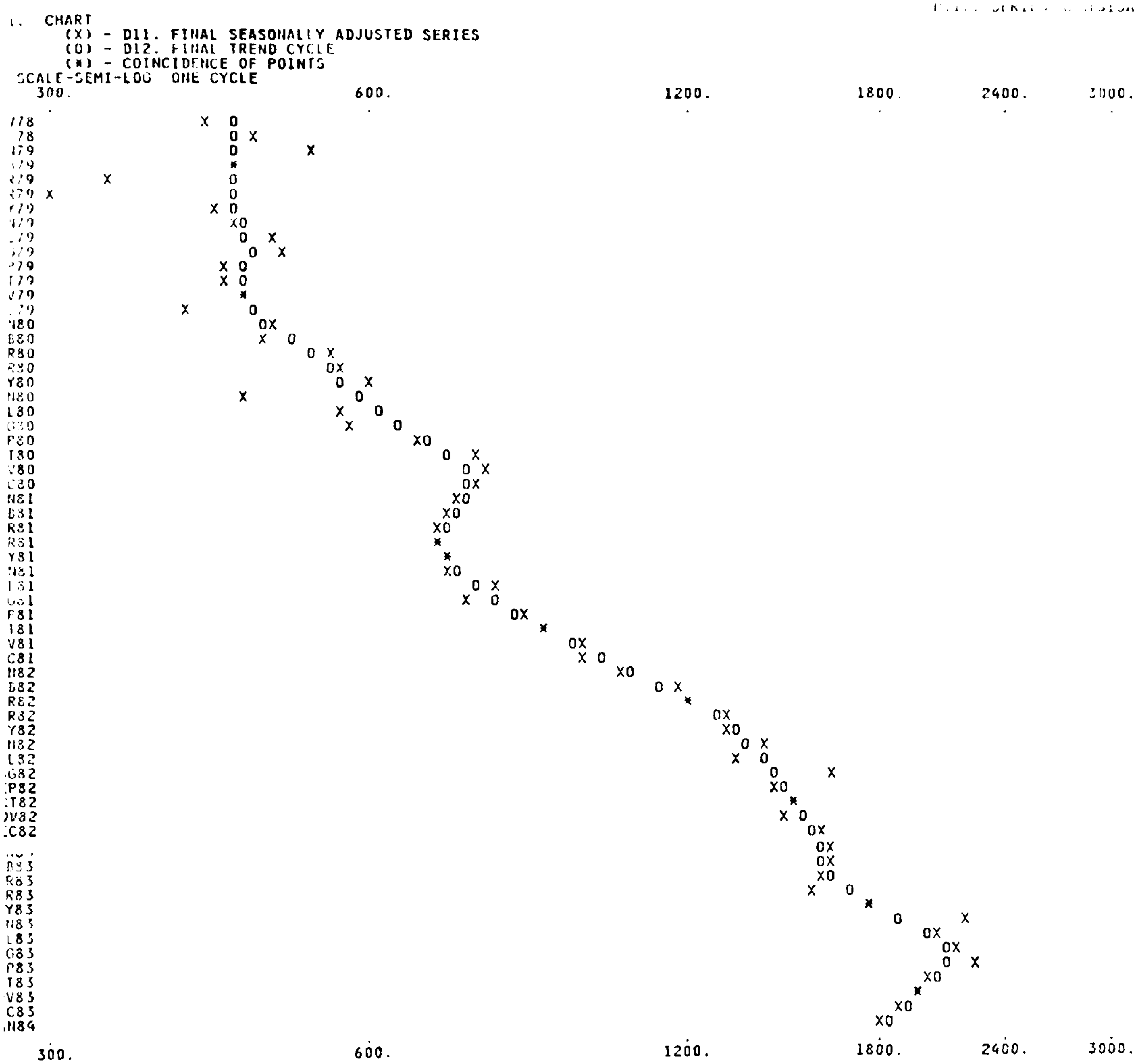

EXHIBIT 2.4b

TREND-CYCLE ADJUSTED ENLISTMENTS

ARMY 1-3A HSSR NPS MALES

November 1978 - January 1984

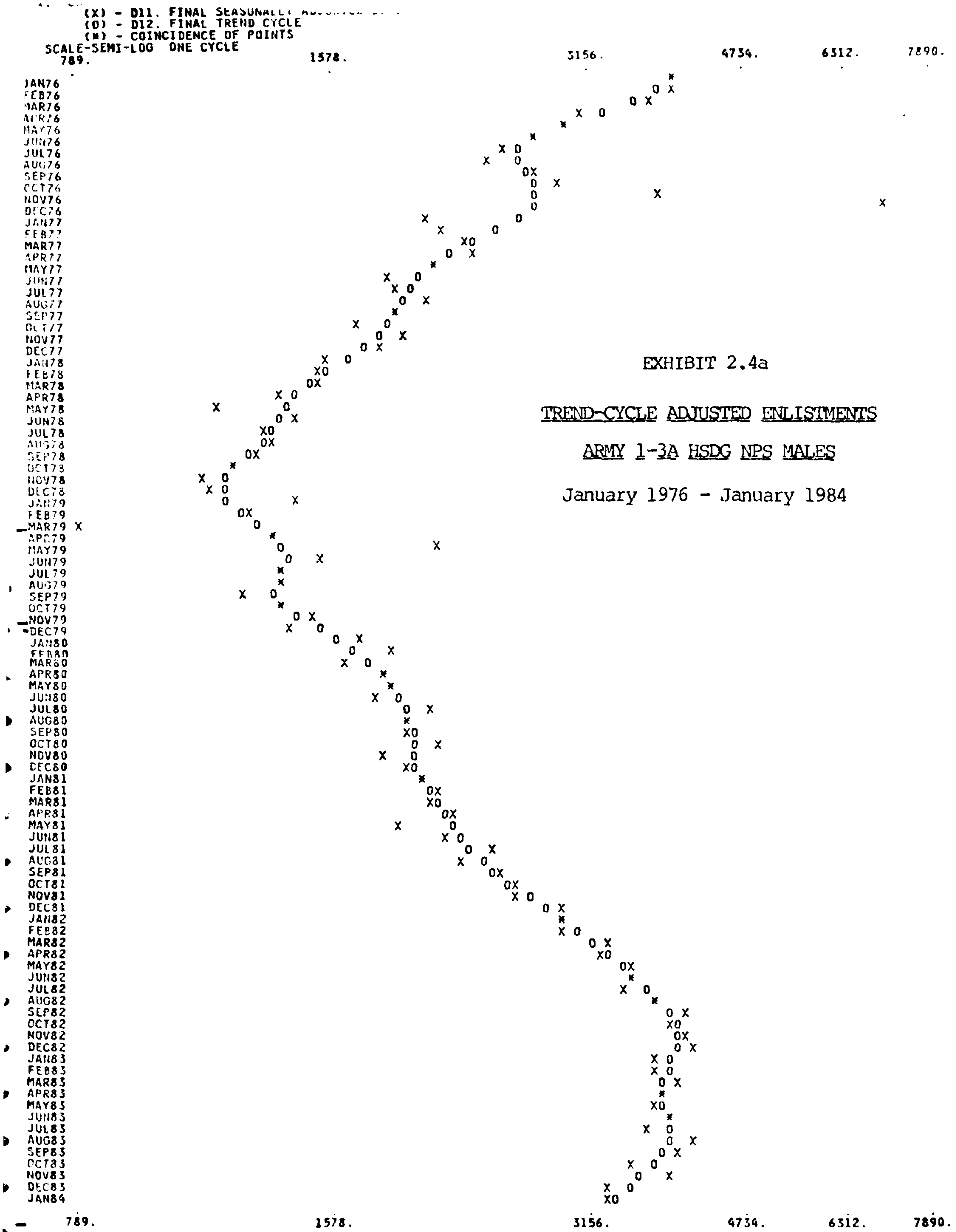

EXHIBIT 2.4a

TREND-CYCLE ADJUSTED ENLISTMENTS

ARMY 1-3A HSDG NPS MALES

January 1976 - January 1984

smoothed as described above. The trend-cycle curves and seasonally-adjusted series for HSDG and HSSR cohorts are shown together in Exhibits 2.4 - 2.7 (trend-cycle is graphed as an O, and seasonally-adjusted series as an X). Bearing in mind the purely statistical nature of this technique, these results suggest the following broad-brush patterns:

- Army HSDG enlistments climbed steadily from 1979 through late 1982, peaking in October-December 1982; HSSR enlistments rose from a local trough at April 1981 to a peak August-September 1983.

- Navy HSDG enlistments also peak around October-November 1982; HSSR enlistments appear to have peaked around September-October 1983.

- Air Force enlistment patterns are different from the other Services; HSDG enlistments declined to a trough in August 1982 and subsequently increased in a step-like fashion; HSSR enlistments reached a trough during November-December 1982 and have been rising subsequently.

- Marine Corps HSDG enlistments peaked in November 1982, and HSSR enlistments peaked in the July-August 1983 period.

These general observations characterize the historical patterns of the recruiting market. The next section examines the role of descriptive statistics in forecasting.

B. Turning Points and Related Descriptive Measures of Enlistment Supply Conditions

Turning point comparisons and related descriptive statistics provide a background for the EEWS forecasts. The pattern of turning points should, in general, corroborate the forecasts. Descriptive measures

EXHIBIT 2.3

ENLISTMENT SEASONAL FACTORS ONE YEAR AHEAD
(BASED ON 7601-8401 DECOMPOSITION)

HSDG COHORTS

MONTH	ARMY 1-3A	NAVY 1-3A	AIR FORCE 1-3	MARINE CORPS 1-3
8402	104.3	104.3	102.0	96.4
8403	101.8	97.3	98.1	84.7
8404	82.1	81.4	83.8	69.5
8405	88.1	76.0	86.1	76.8
8406	111.8	107.5	99.3	126.1
8407	120.2	119.7	114.5	141.1
8408	115.7	125.2	119.2	126.7
8409	106.3	115.3	112.6	116.3
8410	87.8	91.3	90.6	90.3
8411	86.8	90.9	86.3	85.5
8412	85.3	88.3	97.2	84.2
8501	108.4	103.0	110.8	102.2

HSSR COHORTS

MONTH	ARMY 1-3A	NAVY 1-3A	AIR FORCE 1-3	MARINE CORPS 1-3
8402	118.3	127.2	127.5	106.8
8403	133.0	137.6	138.7	106.6
8404	125.0	124.4	131.5	88.4
8405	98.2	90.6	114.4	72.6
8406	76.6	77.0	82.5	101.4
8407	76.8	70.7	64.4	101.6
8408	76.1	77.2	63.1	93.4
8409	70.9	78.5	64.3	96.3
8410	85.9	83.9	66.3	107.3
8411	105.4	102.5	89.8	107.2
8412	118.3	119.1	134.9	110.7
8501	114.9	111.6	122.6	107.2

PLOTS OF SERIES

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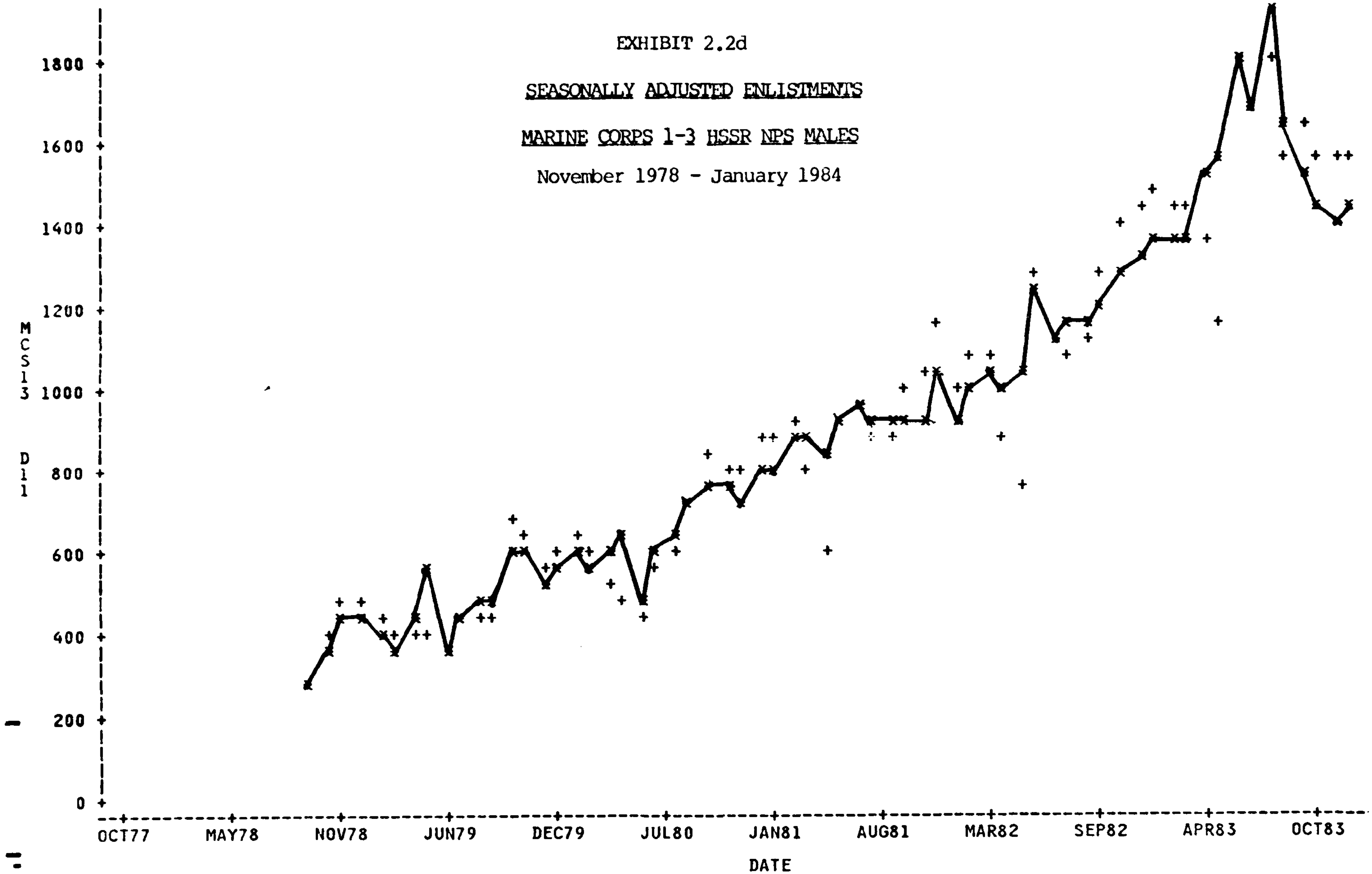
PLOT OF ACTUAL*DATE   SYMBOL USED IS +

EXHIBIT 2.2d

SEASONALLY ADJUSTED ENLISTMENTS

MARINE CORPS 1-3 HSSR NPS MALES

November 1978 - January 1984



PLOTS OF SERIES

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EXHIBIT 2.2c

SEASONALLY ADJUSTED ENLISTMENTS

AIR FORCE 1-3 HSSR NPS MALES

November 1978 - January 1984

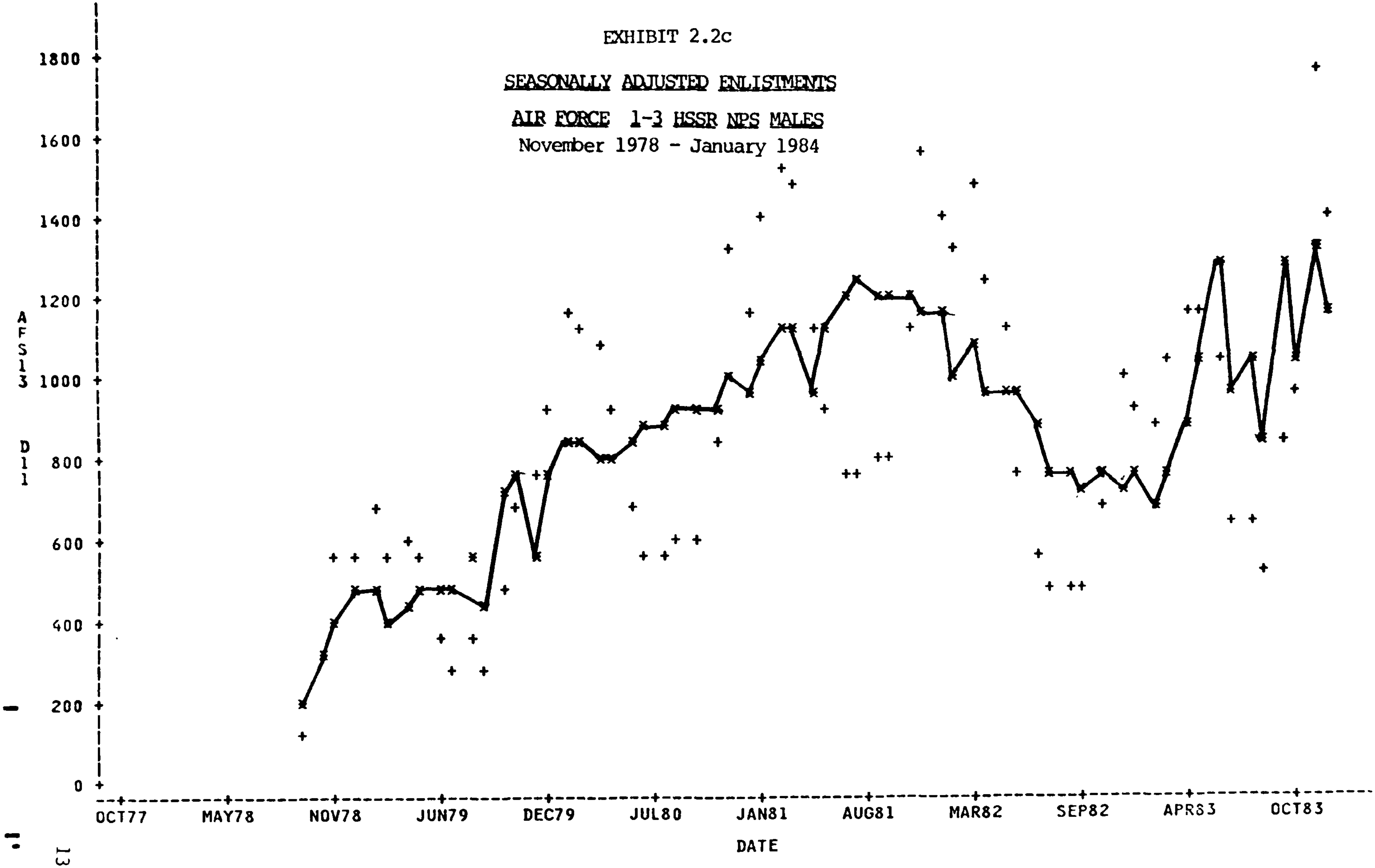

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EXHIBIT 2.2b

SEASONALLY ADJUSTED ENLISTMENTS

NAVY 1-3A HSSR NPS MALES

November 1978 - January 1984

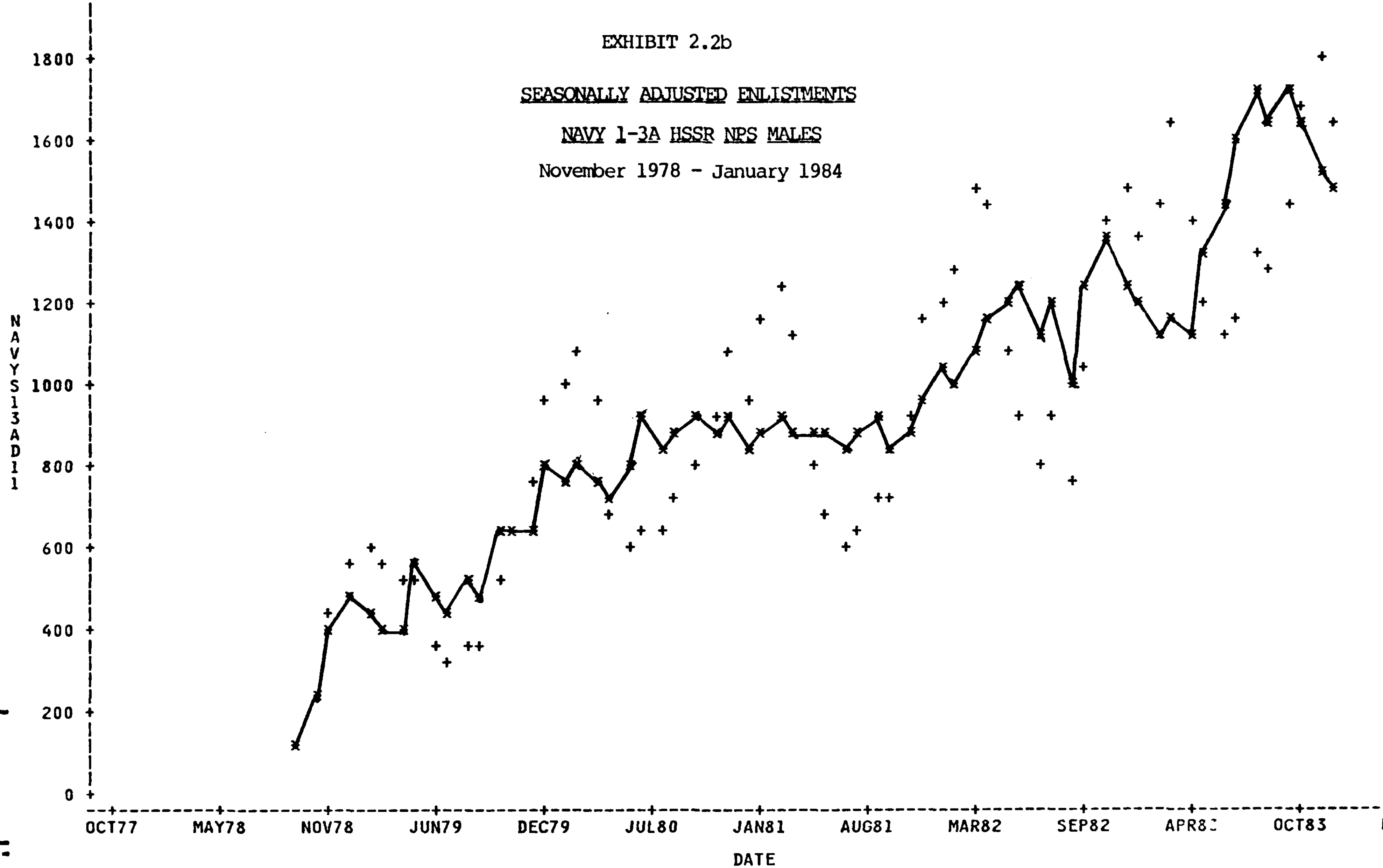

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EXHIBIT 2.2a

<u>SEASONALLY ADJUSTED ENLISTMENTS</u>

<u>ARMY 1-3A HSSR NPS MALES</u>

November 1978 - January 1984

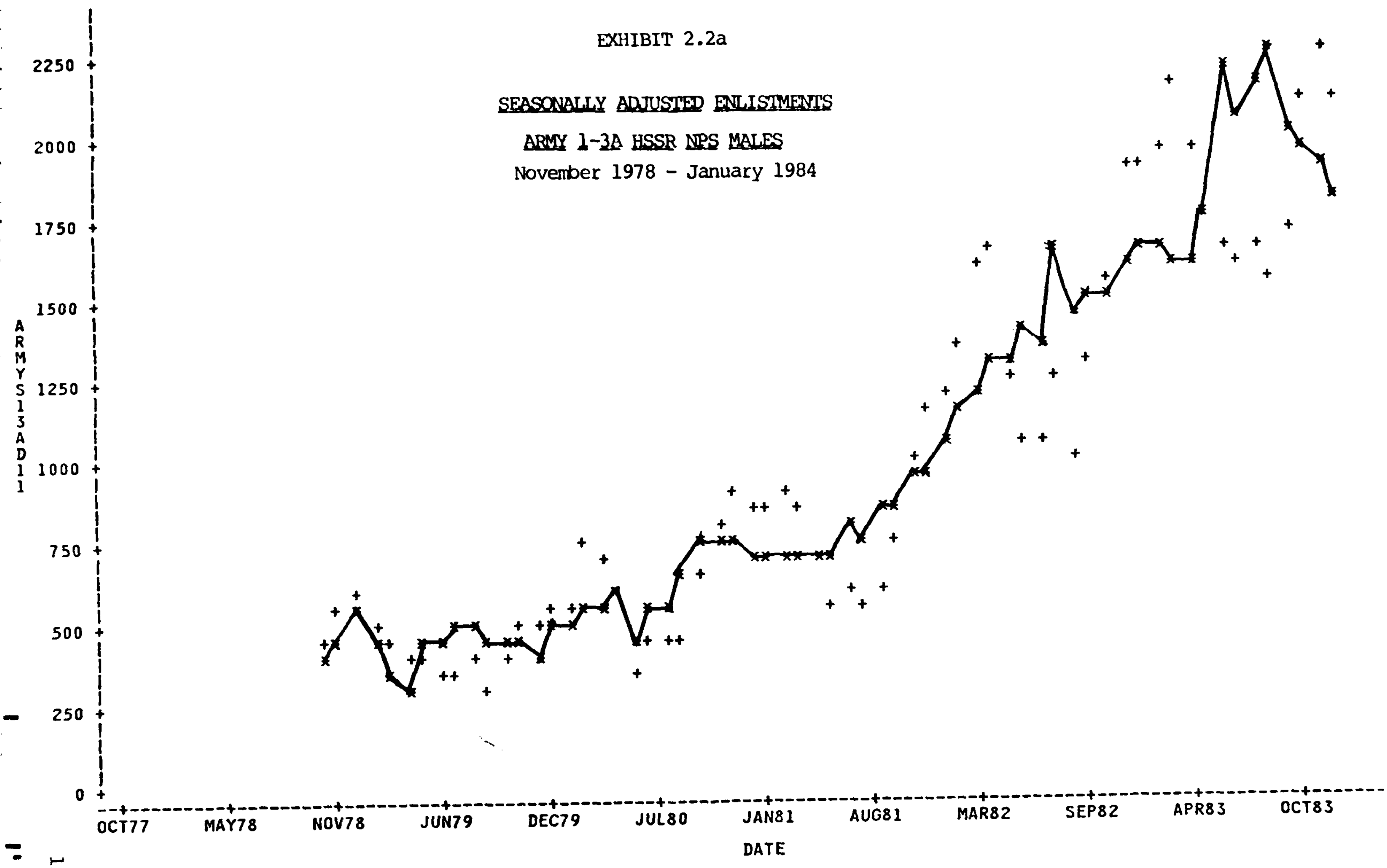

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EXHIBIT 2.1d

<u>SEASONALLY ADJUSTED ENLISTMENTS</u>

<u>MARINE CORPS 1-3 HSDG NPS MALES</u>

January 1976 - January 1984

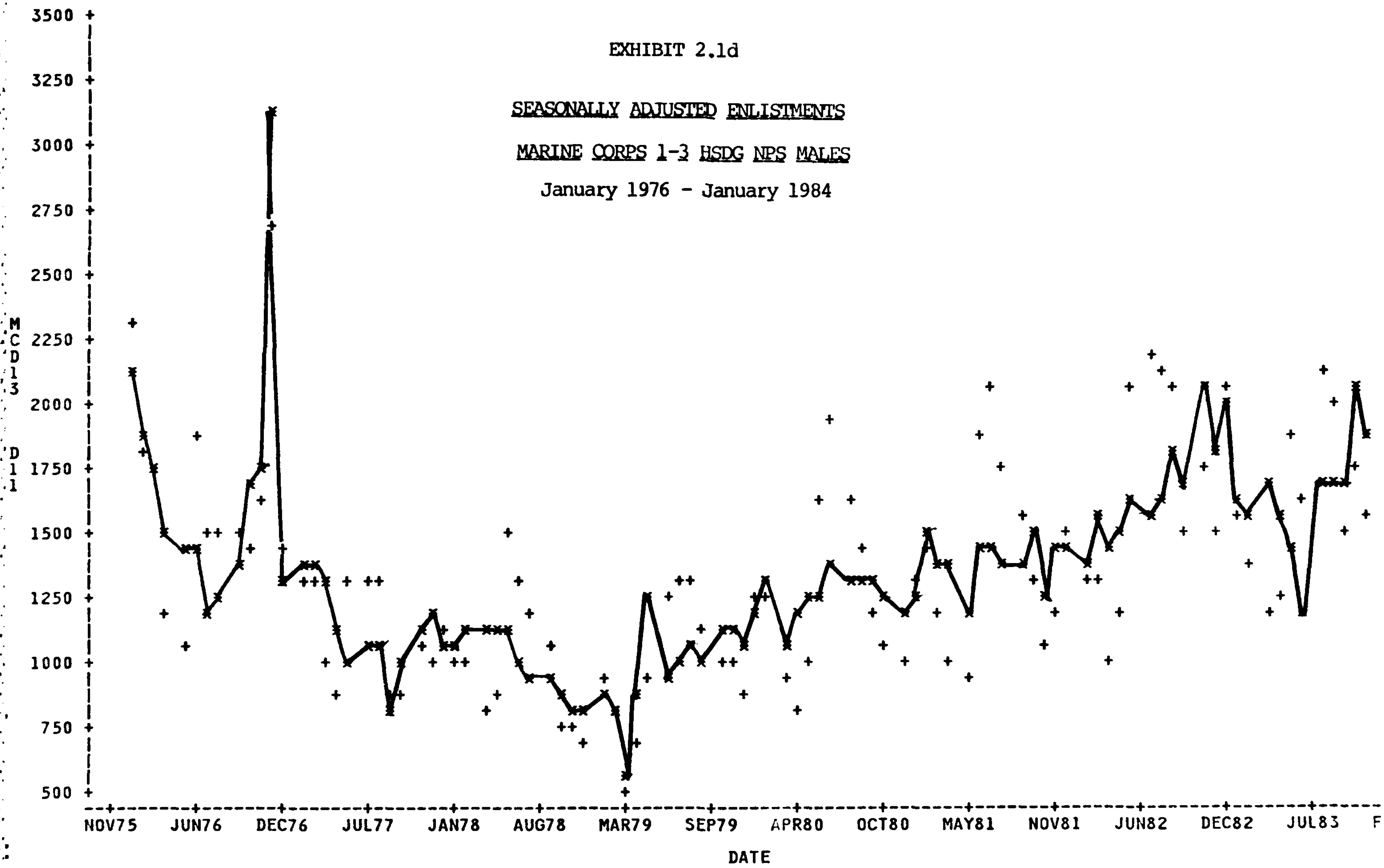

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EXHIBIT 2.1c

SEASONALLY ADJUSTED ENLISTMENTS

AIR FORCE 1-3 HSDG NPS MALES

January 1976 - January 1984

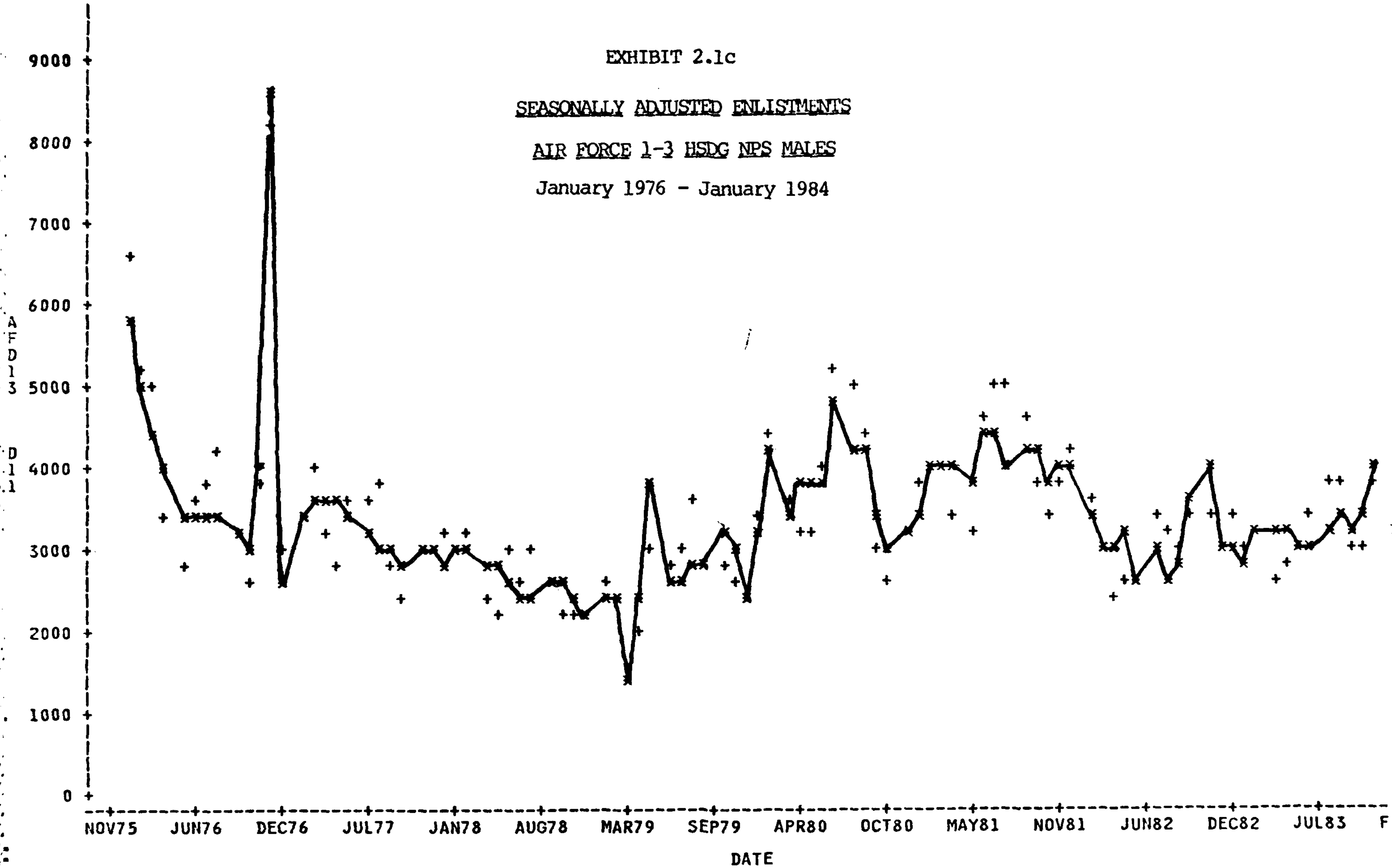

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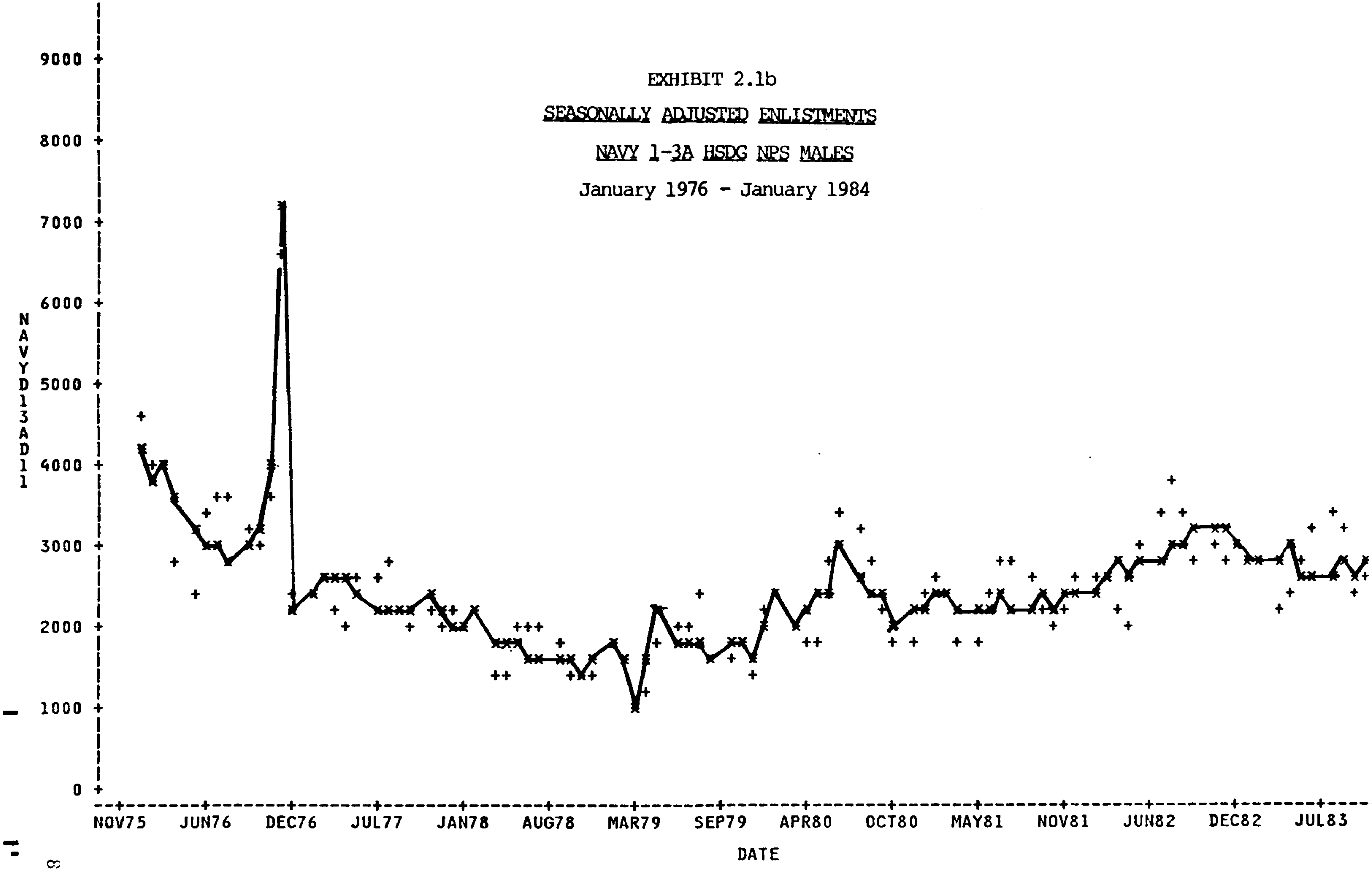
EXHIBIT 2.1b

SEASONALLY ADJUSTED ENLISTMENTS

NAVY 1-3A HSDG NPS MALES

January 1976 - January 1984



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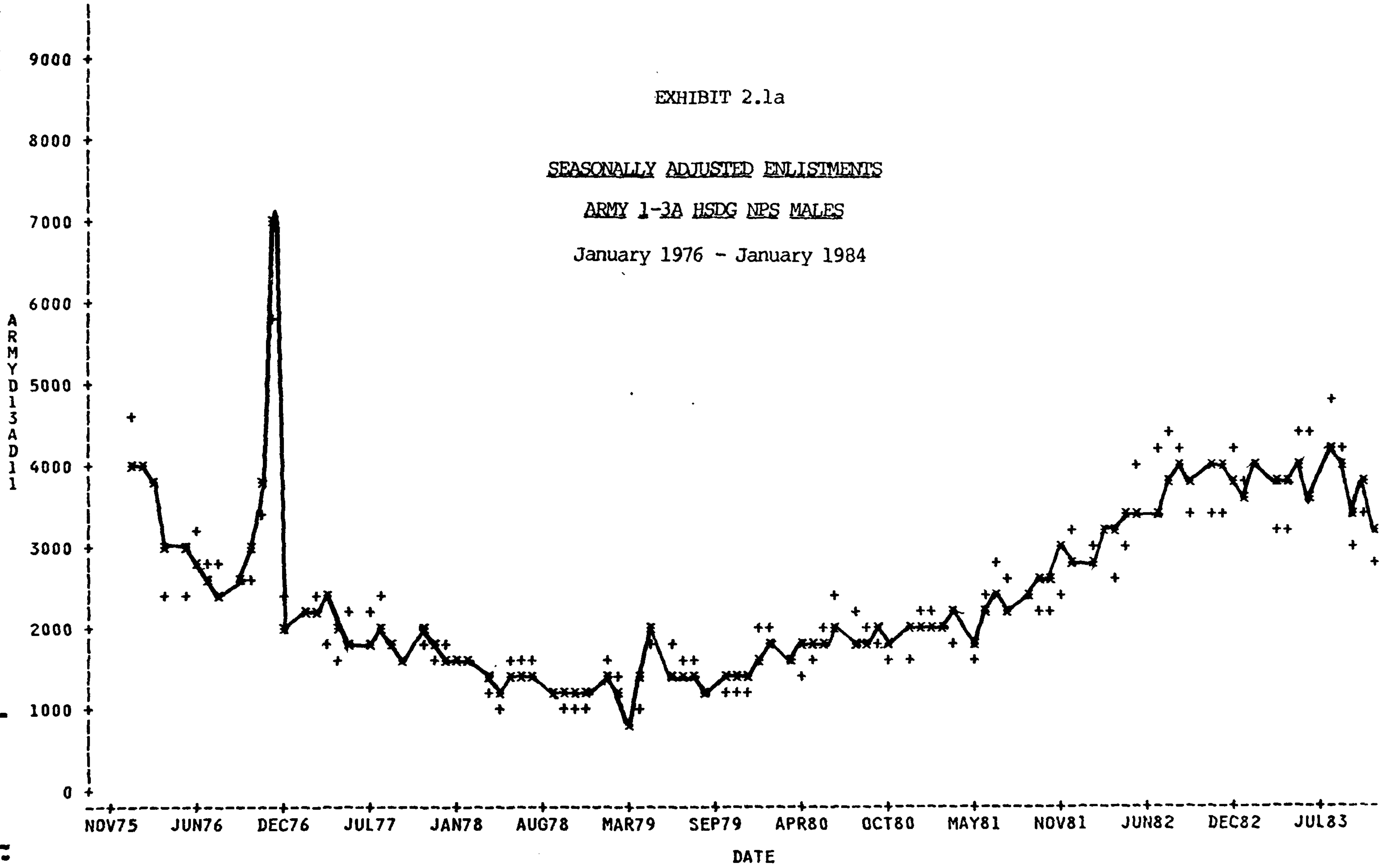

adjusted series shown as the solid line in Exhibits 2.1a-d and 2.2a-d. The HSDG series span the 7601-8401 period and the HSSR series span the 7811-8401 period. From these graphs the reader becomes visually aware of the seasonal variation and the advantages of adjusting for this variation in order to identify other patterns.

In Exhibit 2.3 we report the PROC X-11 estimated seasonal factors one year ahead. These factors can be applied to inflate/deflate new original data as it becomes available. Inspection of the factors clearly reveals that HSDG and HSSR recruiting follow complementary seasonal patterns. HSDG enlistments are strongest during the June-September period, and weakest April-May and October-December. HSSR enlistments are strongest during the December-April period and weakest June-September. This suggests that seasonal variation within the combined HSDG-HSSR cohort would be less.

3. <u>Irregular Variation and the Trend-Cycle Curve</u>

With hindsight it is usually possible to identify extreme irregular movements in a time series and smooth them away so that the trend and cyclical patterns become more apparent. With a purely statistical technique like decomposition there is a certain arbitrariness in deciding how large a change must be before it is considered an extreme change. In the present work we have followed rules-of-thumb developed by others with similar experience. In estimating seasonal and trend-cycle components, irregular values were assigned weights based on their distance from the mean in standard deviation units: irregular values within 1.5 units: were assigned full weight, those between 1.5 and 2.5 units were assigned linearly graduated weights, and those beyond 2.5 units were assigned zero weights.

Using these rules, PROC X-11 calculates a trend-cycle curve that is a seasonally-adjusted series with the irregualr variation

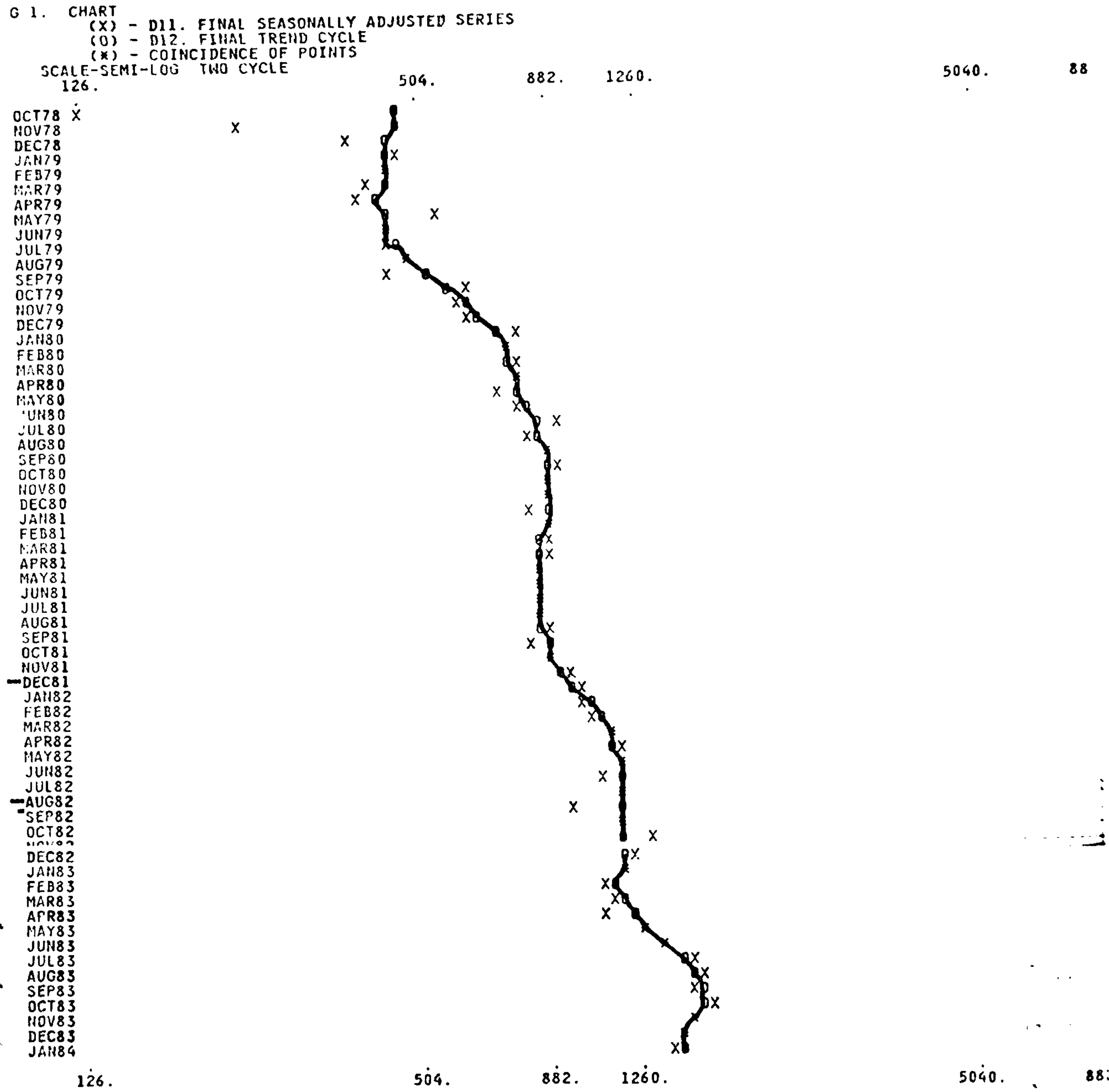

EXHIBIT 2.5b

TREND-CYCLE ADJUSTED ENLISTMENTS

NAVY 1-3A HSSR NPS MALES

November 1978 - January 1984

G 1. CHART
(X) - D11. FINAL SEASONALLY ADJUSTED SERIES
(O) - D12. FINAL TREND CYCLE
(*) - COINCIDENCE OF POINTS
SCALE-SEMI-LOG ONE CYCLE

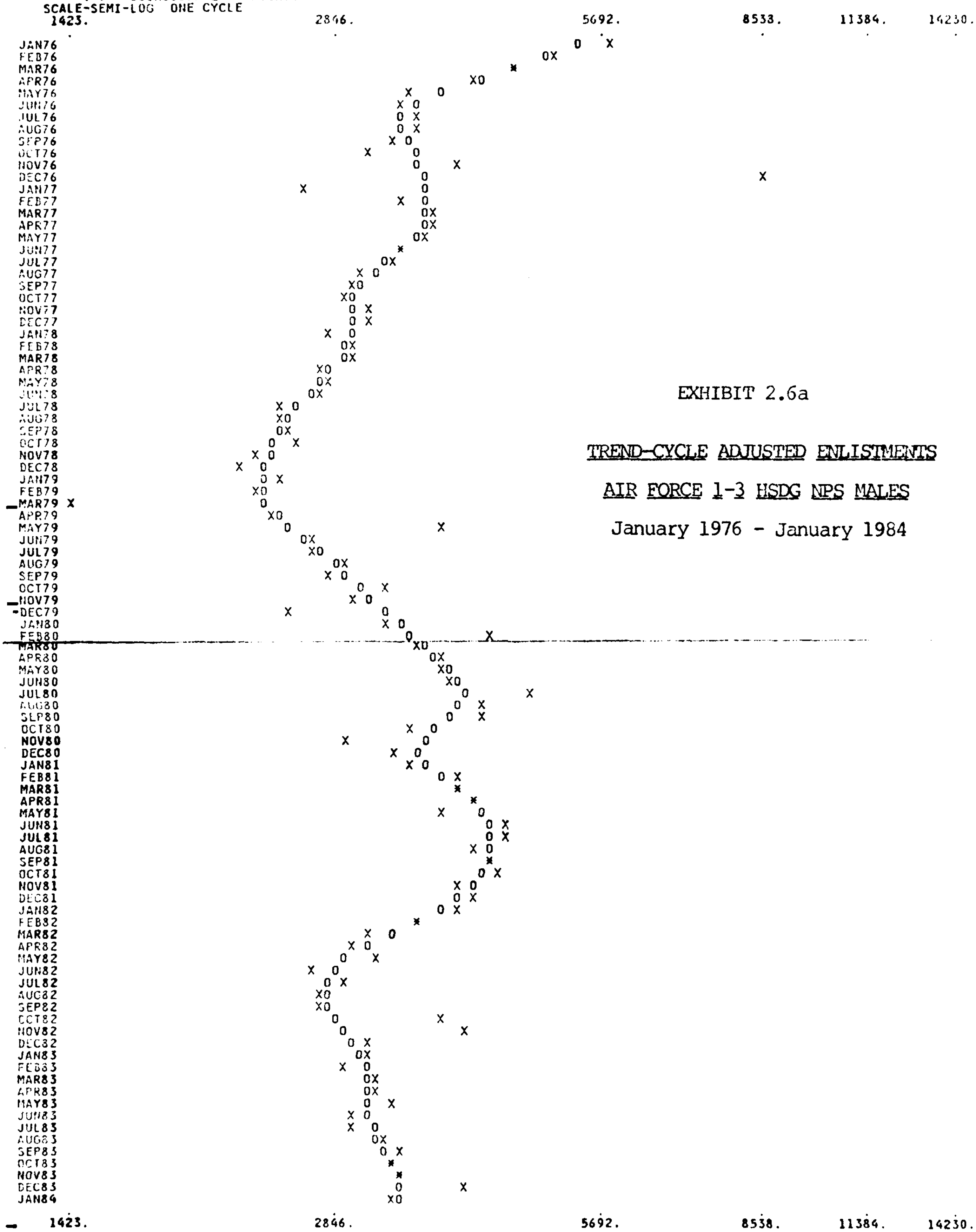

EXHIBIT 2.6a

TREND-CYCLE ADJUSTED ENLISTMENTS

AIR FORCE 1-3 HSDG NPS MALES

January 1976 - January 1984

G 1. CHART
(X) - D11. FINAL SEASONALLY ADJUSTED SERIES
(O) - D12. FINAL TREND CYCLE
(*) - COINCIDENCE OF POINTS
SCALE-SEMI-LOG ONE CYCLE

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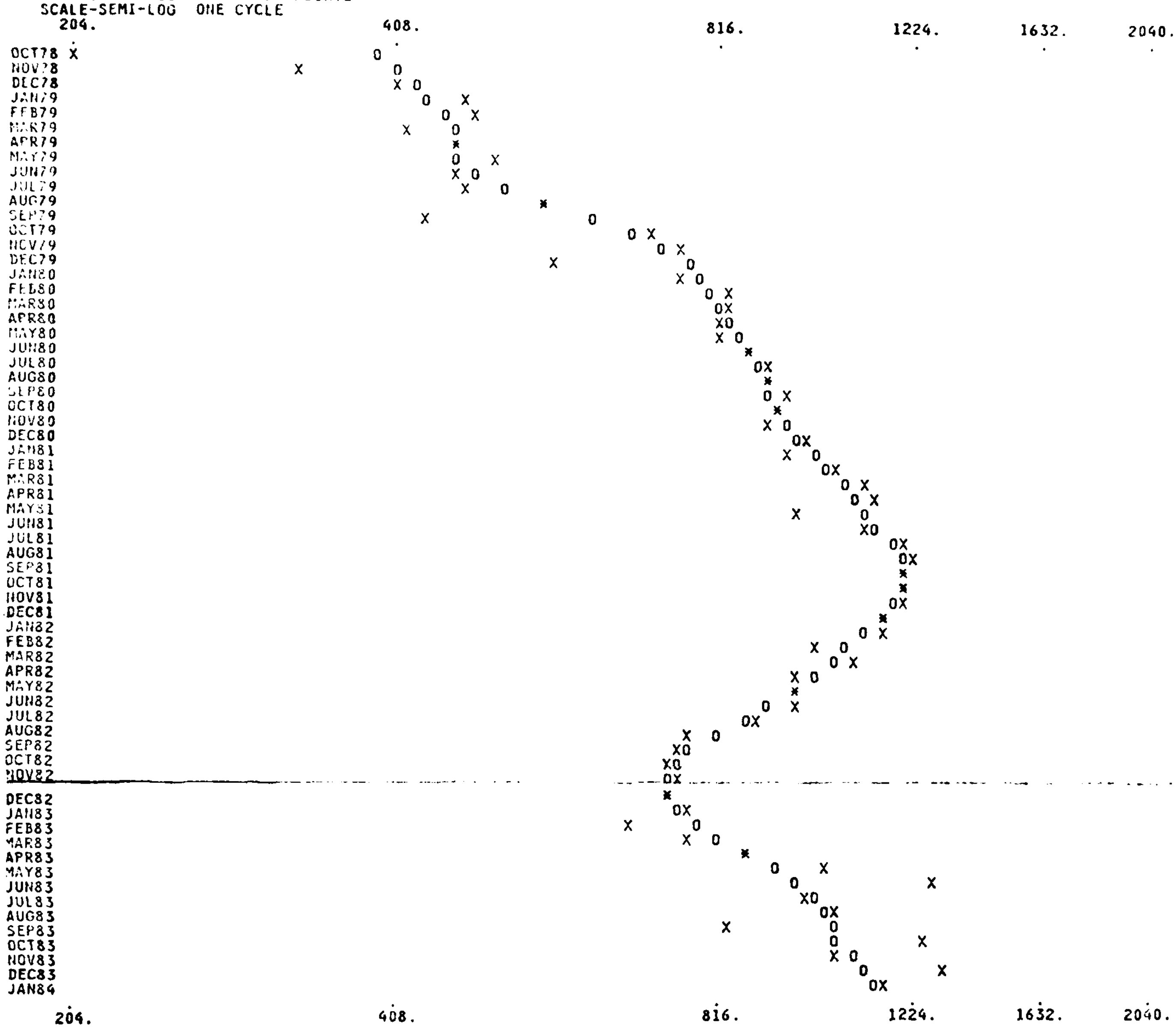

EXHIBIT 2.6b

TREND-CYCLE ADJUSTED ENLISTMENTS

AIR FORCE 1-3 HSSR NPS MALES

November 1978 - January 1984

CHART
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(O) - D12. FINAL TREND CYCLE
(*) - COINCIDENCE OF POINTS
SCALE-SEMI-LOG ONE CYCLE

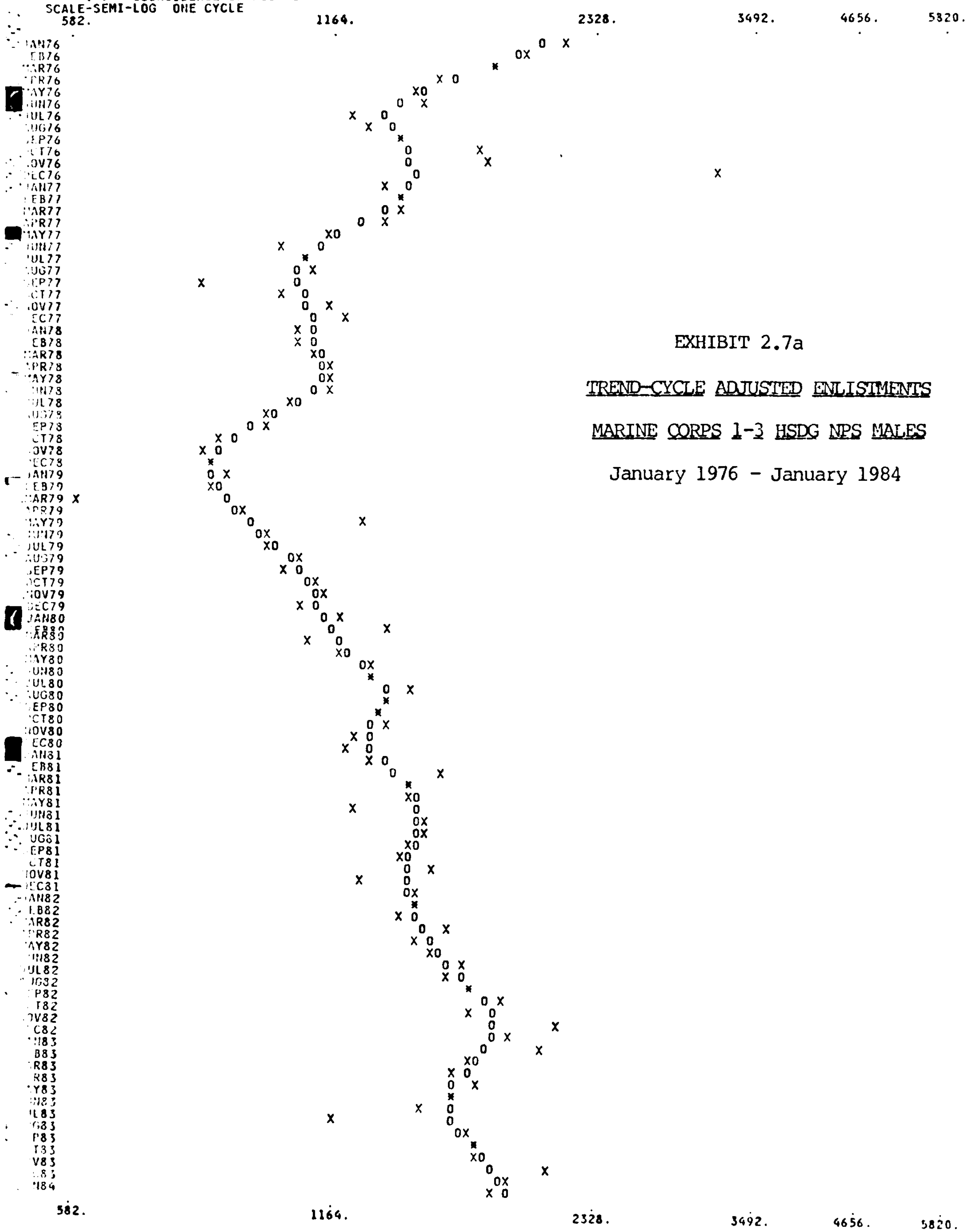

EXHIBIT 2.7a

<u>TREND-CYCLE ADJUSTED ENLISTMENTS</u>

<u>MARINE CORPS 1-3 HSDG NPS MALES</u>

January 1976 - January 1984

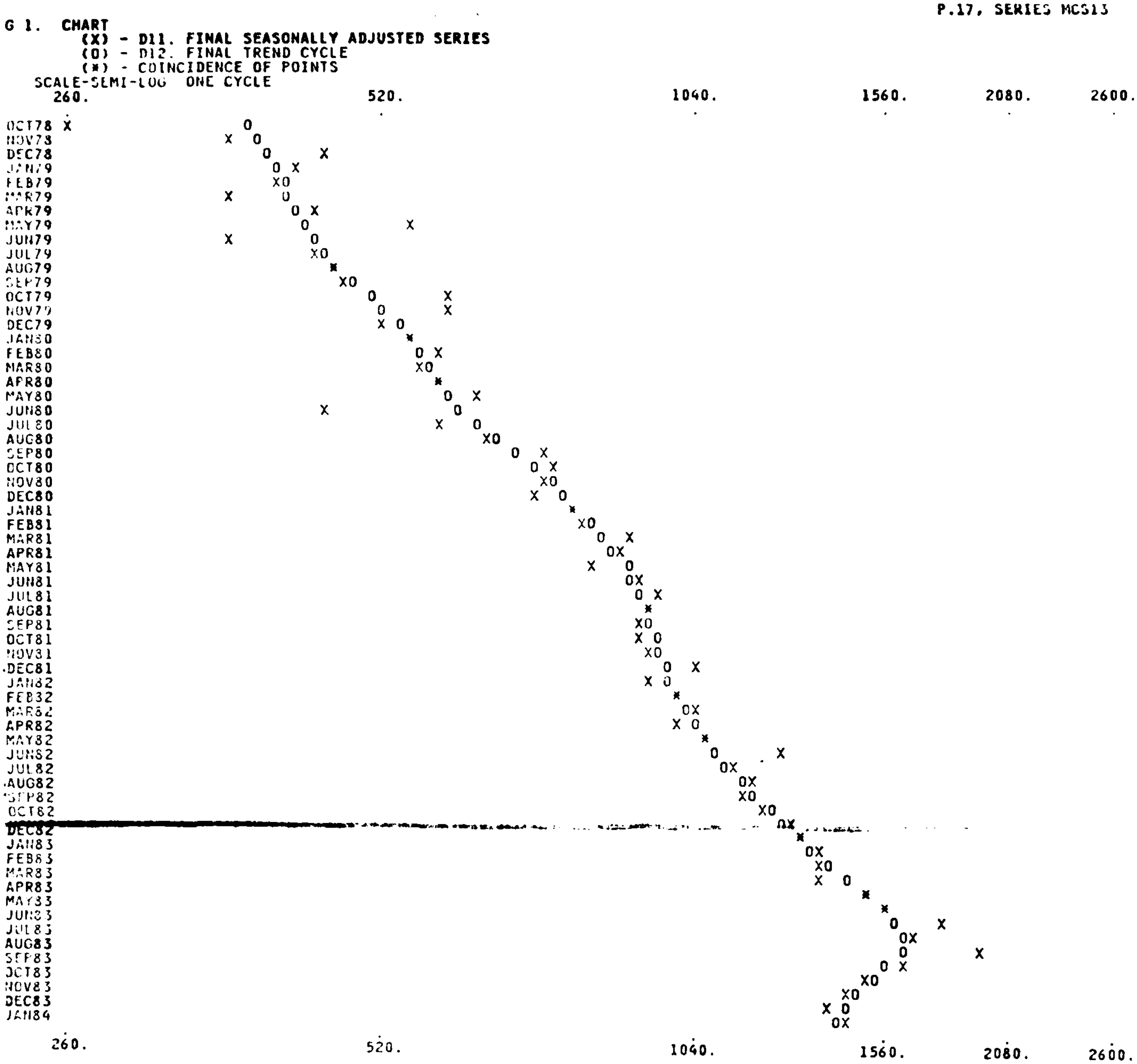

EXHIBIT 2.7b

TREND-CYCLE ADJUSTED ENLISTMENTS

MARINE CORPS 1-3 HSSR NPS MALES

November 1978 - January 1984

related to turning points, such as the patterns of leading indicators, also may amplify and modify the meanings behind the forecasts. While studies of turning points and leading indicators of enlistment supply suggest that descriptive methods, by themselves, fail to match the performance of a good forecasting model, we are recommending that a monthly series of additional statistics accompany the EEWS forecasts.

From the perspective of a forecaster, turning points are useful if they signal the beginning of a long-term trend, and if they can be recognized relatively surely and quickly. This perspective on turning points differs from the historical perspective discussed in the previous section. Historical turning points can be identified as the peaks and troughs of long cycles. The timing of the true, historical turning points may differ from the timing of the _ex ante_ turning points. Hindsight allows us to identify the first sign of a cyclical peak or trough, while the timing of the _ex ante_ turning point includes a recognition lag.

1. Recognition of Ex Ante Turning Points

Were all time series steadily increasing or decreasing in cycles and trends, recognizing turning points would be a trivial matter. Typical time series require both smoothing and judgement to eliminate random perturbations. A single decrease amidst a series of increases, for example, would not qualify as a turning point; the choice of a decision rule for _ex ante_ identification of turning points is far from obvious.

Identifying turning points _ex ante_ introduces the problem of false turning points. Frequently we cannot screen out shifts in direction which, in prospect, appear identical to true turning points. We have chosen a decision rule which, as a practical matter, limits the number of apparent turning points, yet allows fairly quick recognition of the true ones. We define an _ex ante_ turning point as two consecutive months of change in direction from

long-term cycle.

We applied the decision rule to various measures using national and recruiting district-level time-series data on 1-3A (Army and Navy) and 1-3 (Air Force and Marine Corps) HSDG and HSSR contracts. While we had hoped to find a "bellwether" Service and cohort, the results of our analysis did not prove encouraging. In fact, we did not find a consistent bellwether series or Service, and most series signalled false turning points in at least one instance. Exhibit 2.8 summarizes these results.

Turning points by Service and cohort for different types of smoothed data appear in the rows of Exhibit 2.8. We tried three different methods of smoothing the raw data:

a. The annualized monthly growth rate of high-quality contracts, defined as the ratio of the current observation and the observation twelve months prior (referred to as "t/t-12").

   We first applied this method of smoothing to the national data. We also applied it to recruiting district-level data. For the latter, we determined the number of recruiting districts showing increases and the number of those showing decreases. If the difference in numbers increasing and numbers decreasing goes from positive to negative for a two-month time period, we identify a peak turning point. If the difference goes from negative to positive, the turning point is a trough. We refer to the two series as the "t/t-12 national totals" and the "t/t-12 net districts increasing."

b. The deseasonalized value of the observation, as computed by the PROC X11 procedure discussed in the prior section.

c. The "trend-cycle" value from PROC X11.

Exhibit 2.8

TURNING POINTS: CONTRACTS

HSDG 1-3A	t/t-12 NATL. TOTALS Trough	t/t-12 NATL. TOTALS Peak	t/t-12 NET DIST. UP Trough	t/t-12 NET DIST. UP Peak	DECOMPOSITION (X-11) DESEASONALIZED Trough	DECOMPOSITION (X-11) DESEASONALIZED Peak	DECOMPOSITION (X-11) TREND-CYCLE Trough	DECOMPOSITION (X-11) TREND-CYCLE Peak
					HSDG 1-3A's			
ARMY	5/79	10/83	6/79	----	10/76*	2/77*	10/76*	2/77*
					5/79	2/83*	3/79	2/83*
					7/83*	10/83	7/83*	10/83
					SENIORS 1-3A's			
						1/81*		3/81*
					6/81*	11/83	6/81*	11/83
					HSDG 1-3A's			
NAVY	6/79	6/81*	6/79	5/81*	10/76*	2/77*	11/76*	1/77*
	11/81*	7/83	10/81*	7/83	3/79	4/80*	3/79	10/80*
					5/80*	9/80*	12/82*	1/83*
					1/82*	2/83*		
					9/83*	1/84		
					SENIOR 1-3A's			
					12/81*	2/81*	10/81*	4/81*
					8/83*	1/83*		12/83
						10/83		

continued

Exhibit 2.8 (continued)

TURNING POINTS: CONTRACTS

HSDG 1-3A	t/t-12 Natl. TOTALS Trough	t/t-12 Natl. TOTALS Peak	t/t-12 NET DIST. UP Trough	t/t-12 NET DIST. UP Peak	DECOMPOSITION (X-11) DESEASONALIZED Trough	DECOMPOSITION (X-11) DESEASONALIZED Peak	DECOMPOSITION (X-11) TREND-CYCLE Trough	DECOMPOSITION (X-11) TREND-CYCLE Peak
					HSDG 1-3A's			
AIR	6/79	2/82*	7/79	3/82*	10/76*	6/77*	10/76*	6/77*
FORCE	4/83*	---	3/83*	---	5/79	9/80*	5/79	9/80*
					1/81*	9/81*	2/81*	11/81*
					8/82*	7/83*	11/82*	11/81*
					SENIORS 1-3A's			
					10/81*	12/81*	2/83*	12/81*
					1/83*	3/83*		
					HSDG 1-3A's			
MARINE	6/78*	11/78*	10/79	7/83	9/76*	2/77*	9/76*	2/77*
CORPS	8/79	7/83			11/77*	8/78*	11/77*	7/78*
					5/79	10/80*	3/79	10/80*
					2/81*	9/81*	2/81*	
					1/82*	1/83*		
					SENIORS 1-3A's			
						10/83		10/83

* False signals of turning points appear with asterisks.
** Note that recruiting district data ends 9/83.

Exhibit 2.8 makes obvious the recognition problems caused by random perturbations, policy changes and seasonality. Only the t/t-12 growth rate method applied to the Army HSDG 1-3A contract series yields a smoothed series in which the true turning points, and only the true ones, show up. The turning points indicated by a single smoothing method for any one Service and cohort do not often match the turning points suggested by other methods for the other Services and cohorts. These differences probably reflect changes in demand, e.g., new policies and goals, rather than changes in supply.

From the more secure perspective of ex post analysis, we can see that true turning points occur in more than one of the smoothed series and in more than one Service and cohort, at roughly the same point in time. We see nothing to be gained by focussing attention on one series for one Service and cohort. We conclude that by assessing the weight of evidence acquired using alternative methods from all sources, we would significantly reduce the problem of recognizing turning points.

2. Forecasting of Turning Points

A simple correspondence of turning points in a leading series to turning points in enlistments would greatly enhance our ability to forecast downturns. We examined whether data on unemployment or enlistments from selected recruiting districts offer reliable means of predicting turning points of enlistments at the national level.

a. Do Ex Ante Unemployment Turning Points Lead True Enlistment Turning Points?

Exhibit 2.9 contains a listing of turning points derived for alternative unemployment series. Turning points in the unemployment series occur roughly when there are turning points in the enlistment series. For example, unemployment and enlistments definately stop falling during 1979 and quit rising

EXHIBIT 2.9

TURNING POINTS: UNEMPLOYMENT

	X-II			
	SEASONALLY ADJUSTED		TREND CYCLE	
MALE UNEMPLOYMENT (SEASONALLY-ADJUSTED)	TROUGH	PEAK	TROUGH	PEAK
	12/73	10/75	12/73	9/75
	7/76*	1/77*	6/76*	1/77*
	8/78*	5/79*	12/78*	6/79*
	7/79	9/80	8/79	9/80
	3/81	1/83	8/81	1/83
MALE, YOUTH UNEMPLOYMENT (16-19)	TROUGH	PEAK	TROUGH	PEAK
	3/73*	7/73*		
	9/73	8/75	9/73	8/75
	1/75*	3/76*		
	5/76*	6/76*		
	8/76*	1/77	9/76*	1/77
	3/78*	5/78*		
	9/78*	2/79*	10/78*	4/79*
	3/80	12/80*	1/80	4/81*
	8/81*	2/83	8/81*	1/83

* False signals of turning points.

in 1983. While they do correspond in the expected manner, the precise pattern between the series is not stable through time. *Ex ante* assessment of the unemployment data would, in some cases, yield turning points that lag rather than lead turning points in enlistments. The pronounced upturns in Army, Navy, and Air Force enlistments during mid-1979 actually preceded the first clear signs of an upward cycle in overall, male unemployment rate. Youth unemployment rates "bottomed out" much earlier, but the erratic path of that series makes it a poor leading indicator of enlistment turning points. In addition to these lags, there are brief episodes in the unemployment series which give false leading signals of enlistment supply downturns. That situation occurred during the Fall of 1980, when overall male unemployment fell, only to resume a long upward cycle later. Although the effects of this episode appear in the deseasonalized and trend-cycle series for the Navy, Air Force, and Marines, the magnitude of the downturn prove to be scattered and small. In sum, no simple relationship exists between unemployment turning points and subsequent enlistment turning points.

b. *Do Ex Ante Recruiting District Turning Points Lead Enlistment Supply Turning Points?*

Exhibit 2.10 shows the instances of leading recruiting districts (Air Force Squadrons) by Service and turning point. Using data on HSDG 1-3A contracts as a measure of enlistments, we applied the t/t-12 method discussed earlier to produce annualized growth rates. In this case, we have compared recruiting district contract production growth rates with national contract growth rates during the following months. Exhibit 2.10 helps us to see the leading districts at each turning point.

The exhibit indicates little stability in the leading

EXHIBIT 2.10

LEADING RECRUITING DISTRICTS

(Air Force Squadrons 35__)

ARMY	34	44	45	49	50	55	56			
TROUGH (5/79)	N	N	Y	Y	Y	N	Y			
PEAK (9/83)	Y	Y	N	N	N	Y	N			

NAVY	11	14	19	31	37	43	52	61	63	68
TROUGH (6/79)	Y	N	N	Y	Y	N	N	Y	N	Y
PEAK (7/83)	N	Y	Y	N	N	Y	Y	N	Y	N

AIR FORCE	11	14	31	32	35	41	45	48	54
TROUGH (6/79)	Y	Y	Y	Y	Y	Y	Y	Y	Y
PEAK	?	?	?	?	?	?	?	?	?

MARINE CORPS	13	31	32	33	49	61	62	66	67
TROUGH (8/79)	N	Y	Y	Y	N	Y	Y	N	N
PEAK (7/83)	Y	N	Y	Y	Y	N	N	Y	Y

Y'S denote instances when recruiting districts lead turning points in Service HSDG 1-3A or 1-3 contracts, January 1976 - September 1983.

districts from turning point to turning point. If a district leads an upturn it may not lead the next downturn, e.g., Army #28. These results in conjunction with our study of the correlations between leading districts and national totals, and related results from the inclusion of leading districts as leading indicators in forecasting models, suggest that the tracking of bellwether districts may not be worthwhile (see Chapter V).

Neither the unemployment series nor the recruiting district series appears to lead the high-quality enlistment series in a stable manner. The main use of this information would be to monitor general trends and corroborate the EEWS models' forecasts.

3. Other Descriptive Measures

The EEWS will provide a rich assortment of descriptive measures which can be used by recruiting commands and by assessment groups during times of alerts. Seasonal and trend-cycle adjustments draw out the current situation and make comparisons more meaningful. Graphs of true turning points and deseasonalized enlistment time series would prove useful in comparisons of current shifts in the series with those at prior turning points. Similar graphs linking turning points in unemployment rates, recruiters, goals, relative military pay, and changes in programs and policies would illustrate the differences between present conditions and prior conditions. Although the forecasting model summarizes most, if not all, of this information, descriptive statistics and visual displays assist in interpreting the EEWS forecasts. (See the sample EEWS monthly report outline in Chapter VI.)

Descriptive analysis of recruiting market conditions has played an important role in the development of the EEWS forecasting models. The results of descriptive analysis will provide useful additions to

UNIVARIATE TRACKING TESTS
AIR FORCE 1-3AHSDG NPS MALES
January 1977 - March 1983

	OBS	FORECAST	STD ERROR	LOWER 95%	UPPER 95%	ACTUAL	RESIDUAL
	1	2492.4316	346.2156	1813.8629	3171.0003	2333.0000	-159.4316
	2	2335.7214	346.2156	1657.1527	3014.2901	2569.0000	233.2786
	3	2630.0437	346.2156	1951.4750	3308.6124	3027.0000	396.9563
	4	2838.9173	346.2156	2160.3486	3517.4860	2402.0000	-436.9173
	5	2184.2651	346.2156	1505.6964	2862.8337	2230.0000	45.7349
	6	2435.2448	346.2156	1756.6761	3113.8134	2765.0000	329.7552
	7	2669.9872	346.2156	1991.4185	3348.5559	2660.0000	-9.9872
	8	2560.7150	346.2156	1882.1463	3239.2837	2811.0000	250.2850
	9	2919.2673	346.2156	2240.6986	3597.8360	2163.0000	-756.2673
7710	10	1852.9380	346.2156	1174.3693	2531.5067	1808.0000	-44.9380
	11	2189.3899	346.2156	1510.8212	2867.9586	2214.0000	24.6101
	12	2565.3481	346.2156	1886.7794	3243.9168	2207.0000	-358.3481
	13	2183.5746	346.2156	1505.0059	2862.1433	2324.0000	140.4254
	14	2683.4412	346.2156	2004.8726	3362.0099	2326.0000	-357.4412
	15	2233.8453	346.2156	1555.2766	2912.4140	2398.0000	164.1547
	16	2242.9452	346.2156	1564.3765	2921.5139	1794.0000	-448.9452
	17	1921.2683	346.2156	1242.6996	2599.8370	1645.0000	-276.2683
	18	2137.0371	346.2156	1458.4684	2815.6058	2162.0000	24.9629
	19	2436.7899	346.2156	1758.2212	3115.3586	1959.0000	-477.7899
	20	2091.0407	346.2156	1412.4720	2769.6094	2144.0000	52.9593
	21	2206.4848	346.2156	1527.9162	2885.0535	1778.0000	-428.4848
7810	22	1605.8314	346.2156	927.2627	2284.4001	1594.0000	-11.8314
	23	1976.9687	346.2156	1298.4000	2655.5374	1552.0000	-424.9687
	24	1831.4161	346.2156	1152.8474	2509.9847	1526.0000	-305.4161
	25	1864.6412	346.2156	1186.0725	2543.2099	1967.0000	102.3588
	26	2223.7771	346.2156	1545.2084	2902.3458	1760.0000	-463.7771
	27	1701.8026	346.2156	1023.2339	2380.3713	1086.0000	-615.8026
	28	1372.4161	346.2156	693.8474	2050.9848	1545.0000	172.5839
	29	1897.0938	346.2156	1218.5251	2575.6625	2232.0000	334.9062
	30	2238.7882	346.2156	1560.2195	2917.3569	2028.0000	-210.7882
	31	1951.6693	346.2156	1273.1006	2630.2380	2030.0000	78.3307
	32	2068.7939	346.2156	1390.2252	2747.3625	2502.0000	433.2061
	33	2158.9603	346.2156	1480.3916	2837.5290	1966.0000	-192.9603
7910	34	1938.7949	346.2156	1260.2262	2617.3636	1965.0000	26.2051
	35	2213.1457	346.2156	1534.5770	2891.7144	1848.0000	-365.1457
	36	1782.4278	346.2156	1103.8591	2460.9965	1698.0000	-84.4278
	37	2073.0515	346.2156	1394.4828	2751.6202	2526.0000	452.9485
	38	2701.7062	346.2156	2023.1375	3380.2749	3197.0000	495.2938
	39	2440.3049	346.2156	1761.7363	3118.8736	2620.0000	179.6951
	40	2417.5195	346.2156	1738.9508	3096.0882	2316.0000	-101.5195
	41	2353.7628	346.2156	1675.1941	3032.3315	2272.0000	-81.7628
	42	2123.7335	346.2156	1445.1648	2802.3022	2855.0000	731.2665
	43	3123.6341	346.2156	2445.0654	3802.2027	3730.0000	606.3659
	44	3607.2411	346.2156	2928.6724	4285.8098	3574.0000	-33.2411
	45	2757.7202	346.2156	2079.1515	3436.2889	3069.0000	311.2798
8010	46	2714.0697	346.2156	2035.5010	3392.6384	2477.0000	-237.0697
	47	2180.3522	346.2156	1501.7836	2858.9209	2044.0000	-136.3522
	48	2406.5593	346.2156	1727.9906	3085.1280	2175.0000	-231.5593
	49	2874.7949	346.2156	2196.2262	3553.3636	2714.0000	-160.7949
	50	3044.5679	346.2156	2365.9992	3723.1366	2966.0000	-78.5679
	51	2908.8179	346.2156	2230.2492	3587.3866	2898.0000	-10.8179
	52	2526.2684	346.2156	1847.6997	3204.8371	2507.0000	-19.2684
	53	2204.7214	346.2156	1526.1527	2883.2901	2329.0000	124.2786
	54	2654.5563	346.2156	1975.9876	3333.1250	3200.0000	545.4437
	55	3451.1039	346.2156	2772.5352	4129.6726	3531.0000	79.8961
	56	3019.0136	346.2156	2340.4449	3697.5823	3549.0000	529.9864
	57	3263.5514	346.2156	2584.9827	3942.1201	3287.0000	23.4486
8110	58	2641.7953	346.2156	1963.2266	3320.3640	2744.0000	102.2047
	59	2470.2643	346.2156	1791.6956	3148.8330	2395.0000	-75.2643
	60	2639.2742	346.2156	1960.7055	3317.8429	2843.0000	203.7258
	61	2910.7242	346.2156	2232.1555	3589.2929	3159.0000	248.2758
	62	2998.6045	346.2156	2320.0358	3677.1731	2672.0000	-326.6045
	63	2487.5385	346.2156	1808.9698	3166.1072	2254.0000	-233.5385
	64	2296.9143	346.2156	1618.3456	2975.4830	1854.0000	-442.9143
	65	2042.6540	346.2156	1364.0853	2721.2227	1994.0000	-48.6540
	66	2631.2563	346.2156	1952.6876	3309.8250	1984.0000	-647.2563
	67	2251.9334	346.2156	1573.3648	2930.5021	2439.0000	187.0666
	68	2750.5085	346.2156	2071.9398	3429.0772	2398.0000	-352.5085
	69	2216.8510	346.2156	1538.2823	2895.4197	2223.0000	6.1490
8210	70	2222.4202	346.2156	1543.8515	2900.9889	2582.0000	359.5798
	71	2595.9279	346.2156	1917.3593	3274.4966	2752.0000	156.0721
	72	2554.9534	346.2156	1876.3847	3233.5221	2422.0000	-132.9534
	73	2557.8243	346.2156	1879.2556	3236.3930	2741.0000	183.1757
	74	2573.1512	346.2156	1894.5825	3251.7199	2416.0000	-157.1512
8303	75	21[illegible].5802	346.2156	1449.0115	2806.1489	2598.0000	470.4193

EXHIBIT 3.5b

UNIVARIATE TRACKING TESTS
NAVY 1-3A USDG NPS SALES
February 1978 - March 1983

SAS 11:01 SA

FORECASTS FOR VARIABLE NAVYD13A

	OBS	FORECAST	STD ERROR	LOWER 95%	UPPER 95%	ACTUAL	RESIDUAL
7802	14	2061.0000	262.8928	1545.7406	2576.2594	2008.0000	-53.0000
	15	2211.0000	262.8928	1695.7406	2726.2594	2105.0000	-106.0000
	16	1674.0870	262.8928	1158.8276	2189.3465	1500.0000	-174.0870
	17	1418.1740	262.8928	902.9146	1933.4335	1482.0000	63.8260
	18	2122.4023	262.8928	1607.1429	2637.6618	2009.0000	-113.4023
	19	2024.7886	262.8928	1509.5292	2540.0481	1937.0000	-87.7886
	20	2302.6779	262.8928	1787.4184	2817.9373	2080.0000	-222.6779
	21	1464.5539	262.8928	949.2944	1979.8133	1703.0000	238.4461
7810	22	1564.4023	262.8928	1049.1429	2079.6618	1456.0000	-108.4023
	23	1511.1339	262.8928	995.8745	2026.3934	1328.0000	-183.1339
	24	1201.3112	262.8928	686.0517	1716.5706	1331.0000	129.6888
	25	1615.6846	262.8928	1100.4252	2130.9440	1893.0000	277.3154
	26	1678.3597	262.8928	1163.1002	2193.6191	1587.0000	-91.3597
	27	1574.2287	262.8928	1058.9693	2089.4881	1054.0000	-520.2287
	28	527.5430	262.8928	12.2836	1042.8025	1300.0000	772.4570
	29	1515.3033	262.8928	1000.0439	2030.5627	1739.0000	223.6967
	30	1939.6553	262.8928	1424.3958	2454.9147	1933.0000	-6.6553
	31	1805.5077	262.8928	1290.2483	2320.7672	2084.0000	278.4923
	32	2328.8281	262.8928	1813.5687	2844.0875	2304.0000	-24.8281
	33	1727.2053	262.8928	1211.9458	2242.4647	1641.0000	-86.2053
7910	34	1462.6002	262.8928	947.3408	1977.8596	1571.0000	108.3998
	35	1547.9300	262.8928	1032.6706	2063.1894	1711.0000	163.0700
	36	1704.8603	262.8928	1189.6009	2220.1198	1454.0000	-250.8603
	37	1809.2674	262.8928	1294.0080	2324.5269	2219.0000	409.7326
	38	2083.5973	262.8928	1568.3378	2598.8567	2419.0000	335.4027
	39	1853.8498	262.8928	1338.5904	2369.1093	1960.0000	106.1502
	40	1850.7374	262.8928	1335.4779	2365.9968	1704.0000	-146.7374
	41	1962.1308	262.8928	1446.8714	2477.3902	1882.0000	-80.1308
	42	2174.8965	262.8928	1659.6370	2690.1559	2767.0000	592.1035
	43	3059.4151	262.8928	2544.1556	3574.6745	3495.0000	435.5849
	44	3202.2608	262.8928	2687.0014	3717.5203	3282.0000	79.7392
	45	2361.5197	262.8928	1846.2603	2876.7792	2733.0000	371.4803
8010	46	2605.3228	262.8928	2090.0634	3120.5822	2147.0000	-458.3228
	47	1992.4706	262.8928	1477.2112	2507.7300	1799.0000	-193.4706
	48	1817.4422	262.8928	1302.1828	2332.7017	1853.0000	35.5578
	49	2653.0032	262.8928	2137.7438	3168.2626	2393.0000	-260.0032
	50	2474.8313	262.8928	1959.5718	2990.0907	2579.0000	104.1687
	51	2171.4072	262.8928	1656.1478	2686.6666	2311.0000	139.5928
	52	2112.5780	262.8928	1597.3186	2627.8375	1841.0000	-271.5780
	53	1843.1925	262.8928	1327.9331	2358.4520	1762.0000	-81.1925
	54	2552.3643	262.8928	2037.1049	3067.6237	2484.0000	-68.3643
	55	3129.4721	262.8928	2614.2126	3644.7315	2852.0000	-277.4721
	56	2700.3085	262.8928	2185.0491	3215.5679	2731.0000	30.6915
	57	2262.6530	262.8928	1747.3936	2777.9124	2558.0000	295.3470
8110	58	1868.3506	262.8928	1353.0912	2383.6101	2140.0000	271.6494
	59	1557.5004	262.8928	1042.2410	2072.7599	1942.0000	384.4996
	60	1835.6902	262.8928	1320.4308	2350.9497	2139.0000	303.3098
	61	2435.5017	262.8928	1920.2423	2950.7612	2587.0000	151.4983
	62	2749.2300	262.8928	2233.9705	3264.4894	2591.0000	-158.2300
	63	2282.4716	262.8928	1767.2121	2797.7310	2570.0000	287.5284
	64	2219.0303	262.8928	1703.7709	2734.2897	2280.0000	60.9697
	65	2161.3075	262.8928	1646.0481	2676.5669	1994.0000	-167.3075
	66	2668.9738	262.8928	2153.7144	3184.2332	2962.0000	293.0262
	67	3422.5345	262.8928	2907.2751	3937.7940	3371.0000	-51.5345
	68	3188.5779	262.8928	2673.3184	3703.8373	3738.0000	549.4221
	69	3554.4714	262.8928	3039.2120	4069.7308	3392.0000	-162.4714
8210	70	2679.8754	262.8928	2164.6159	3195.1348	2834.0000	154.1246
	71	2720.2552	262.8928	2204.9958	3235.5146	2912.0000	191.7448
	72	2965.1091	262.8928	2449.8497	3480.3686	2766.0000	-199.1091
	73	3001.7106	262.8928	2486.4512	3516.9700	3040.0000	38.2894
	74	3086.8059	262.8928	2571.5465	3602.0654	2860.0000	-226.8059
8303	75	2644.3532	262.8928	2129.0938	3159.6126	2704.0000	59.6468

EXHIBIT 3.5a

UNIVARIATE TRACKING TESTS
ARMY 1-3A HSDC NPS MALES
February 1978 - March 1983

SAS 11:01 SATU

FORECASTS FOR VARIABLE ARMYD13A

	OBS	FORECAST	STD ERROR	LOWER 95%	UPPER 95%	ACTUAL	RESIDUAL
7802	14	1661.5302	274.6144	1123.2970	2199.7635	1592.0000	-69.5302
	15	1727.5979	274.6144	1189.3646	2265.8312	1527.0000	-200.5979
	16	1099.9363	274.6144	561.7030	1638.1696	1106.0000	6.0637
	17	1032.8496	274.6144	494.6163	1571.0828	959.0000	-73.8496
	18	1350.1267	274.6144	811.8934	1888.3600	1672.0000	321.8733
	19	1605.0830	274.6144	1066.8497	2143.3163	1522.0000	-83.0830
	20	1716.9741	274.6144	1178.7408	2255.2073	1579.0000	-137.9741
	21	1166.9358	274.6144	628.7025	1705.1691	1274.0000	107.0642
7810	22	951.7683	274.6144	413.5350	1490.0016	1092.0000	140.2317
	23	1171.9610	274.6144	633.7277	1710.1943	983.0000	-188.9610
	24	764.5565	274.6144	226.3232	1302.7898	942.0000	177.4435
	25	1324.7256	274.6144	786.4923	1862.9589	1640.0000	315.2744
	26	1255.3334	274.6144	717.1001	1793.5667	1311.0000	55.6666
	27	1098.3213	274.6144	560.0880	1636.5546	789.0000	-309.3213
	28	536.1465	274.6144	-2.0868	1074.3798	1095.0000	558.8535
	29	964.7941	274.6144	426.5608	1503.0274	1750.0000	785.2059
	30	1958.0381	274.6144	1419.8048	2496.2714	1745.0000	-213.0381
	31	1452.3734	274.6144	914.1401	1990.6067	1607.0000	154.6266
	32	1970.7109	274.6144	1432.4776	2508.9442	1603.0000	-367.7109
	33	1317.4024	274.6144	779.1692	1855.6357	1207.0000	-110.4024
7910	34	1032.9544	274.6144	494.7211	1571.1876	1227.0000	194.0456
	35	1117.7060	274.6144	579.4727	1655.9392	1259.0000	141.2940
	36	1113.1836	274.6144	574.9503	1651.4168	1159.0000	45.8164
	37	1797.0484	274.6144	1258.8152	2335.2817	1908.0000	110.9516
	38	1573.9407	274.6144	1035.7074	2112.1740	1934.0000	360.0593
	39	1325.7555	274.6144	787.5222	1863.9888	1587.0000	261.2445
	40	1673.3366	274.6144	1135.1033	2211.5699	1483.0000	-190.3366
	41	2124.0881	274.6144	1585.8548	2662.3214	1586.0000	-538.0881
	42	1888.4780	274.6144	1350.2447	2426.7113	2044.0000	155.5220
	43	2068.9884	274.6144	1530.7551	2607.2217	2466.0000	397.0116
	44	2051.2313	274.6144	1512.9980	2589.4646	2204.0000	152.7687
	45	1529.8654	274.6144	991.6322	2068.0987	1901.0000	371.1346
8010	46	2036.6042	274.6144	1498.3709	2574.8374	1825.0000	-211.6042
	47	1820.9398	274.6144	1282.7065	2359.1731	1508.0000	-312.9398
	48	1583.2153	274.6144	1044.9820	2121.4486	1582.0000	-1.2153
	49	2452.7159	274.6144	1914.4826	2990.9492	2259.0000	-193.7159
	50	2202.9176	274.6144	1664.6843	2741.1509	2197.0000	-5.9176
	51	1884.9980	274.6144	1346.7647	2423.2313	2026.0000	141.0020
	52	1910.4339	274.6144	1372.2007	2448.6672	1766.0000	-144.4339
	53	1817.5437	274.6144	1279.3105	2355.7770	1631.0000	-186.5437
	54	2169.7236	274.6144	1631.4904	2707.9569	2451.0000	281.2764
	55	2852.5557	274.6144	2314.3224	3390.7890	2890.0000	37.4443
	56	2491.5180	274.6144	1953.2847	3029.7513	2530.0000	38.4820
	57	2312.6575	274.6144	1774.4243	2850.8908	2481.0000	168.3425
8110	58	2364.3650	274.6144	1826.1317	2902.5983	2285.0000	-79.3650
	59	1837.3746	274.6144	1299.1413	2375.6078	2174.0000	336.6254
	60	2229.1675	274.6144	1690.9342	2767.4008	2422.0000	192.8325
	61	2919.3084	274.6144	2381.0751	3457.5417	3197.0000	277.6916
	62	3062.3774	274.6144	2524.1442	3600.6107	3034.0000	-28.3774
	63	2885.6605	274.6144	2347.4272	3423.8938	3294.0000	408.3395
	64	2970.6317	274.6144	2432.3985	3508.8650	2679.0000	-291.6317
	65	2470.6351	274.6144	1932.4019	3008.8684	3072.0000	601.3649
	66	3914.9377	274.6144	3376.7044	4453.1710	3943.0000	28.0623
	67	4123.0190	274.6144	3584.7857	4661.2522	4167.0000	43.9810
	68	3856.8440	274.6144	3318.6107	4395.0772	4335.0000	478.1560
	69	4271.4399	274.6144	3733.2066	4809.6731	4191.0000	-80.4399
8210	70	3754.4392	274.6144	3216.2059	4292.6724	3413.0000	-341.4392
	71	3483.0552	274.6144	2944.8220	4021.2885	3483.0000	-0.0552
	72	3932.7354	274.6144	3394.5022	4470.9687	3444.0000	-488.7354
	73	4190.6431	274.6144	3652.4099	4728.8764	4125.0000	-65.6431
	74	4119.6036	274.6144	3581.3703	4657.8368	3863.0000	-256.6036
8303	75	4145.3319	274.6144	3607.0986	4683.5652	4037.0000	-108.3319

EXHIBIT 3.4

SUMMARY STATISTICS
MONITORING WITH TIME-SERIES MODELS

COHORT	MEAN	UNIVARIATE	BIVARIATE	
			ALLUNEMP	YTHUNEMP
		SEE	SEE	SEE
HSDG (7601-8303)				
ARMY 1-3A	2447	274	267	259
NAVY 1-3A	2471	262	270	267
AIR FORCE 1-3A	2544	346	382	__[a]
MARINE CORPS 1-3A	896	(log).154	.15	.156
HSSR (7811-8303)				
ARMY 1-3A	653	(log).136		
NAVY 1-3A	616	(log).157		
AIR FORCE 1-3A	392	(log).147		
MARINE CORPS 1-3A	359	61		

a A relationship could not be estimated due to insufficient cross correlation.

EXHIBIT 3.3

UNIVARIATE TIME SERIES ESTIMATED EQUATIONS*

1-3A HSDG COHORTS (7601-8312)

ARMY	$(1 - B^1)(1 - B^{12})(1 + .21B^1 + .37B^2)X_t = (1 - .31B^{16})e_t$
NAVY	$(1 - B^1)(1 - B^{12})X_t = (1 - .34B^2)(1 - .57B^{12})e_t$
AIR FORCE	$(1 - .24B^1)(X_t - 2463) = (1 + .61B^1)(1 + .41B^6)(1 + .50B^{12})e_t$
MARINE CORPS	$(1 - B^1)(1 - B^{12})(1 + .33B^1 + .33B^2)LX_t =$ $(1 - .34B^{12})(1 - .32B^{24})e_t$

1-3A HSSR COHORTS (7811-8312)

ARMY	$(1 - B^1)(1 - B^{12})(1 + .37B^3)LX_t = (1 - .41B^{12})e_t$
NAVY	$(1 - B^1)(1 - B^{12})LX_t = (1 - .25B^6 - .31B^{12})e_t$
AIR FORCE	$(1 - B^1)(1-B^{12})(1 + .38)LX_t = e_t$
MARINE CORPS	$(1 - B^1)(1 - B^{12})X_t = (1 - .33B^1)e_t$

X_t = enlistment series
LX_t = logarithm of enlistment series

* All estimated parameters are statistically significant at the .05 level or better.

EXHIBIT 3.2

UNIVARIATE TIME SERIES
HSSR COHORT MODEL RESULTS

COHORT	PARAMETER	LAG	ESTIMATE	STD-ERROR	T-RATIO	AUTOCORRELATION CHECK OF RESIDUALS TO LAG			
						6	12	18	24
LARMS13A						.45	.69	.90	.98
D=(1,12)	AR1,1	1	-.37	.13	-2.74				
P=1, Q=1	MA1,1	1	.41	.15	2.72				
LNAVS13A						.26	.56	.60	.80
D=(1,12)	MA1,1	6	.25	.14	1.76				
Q=(6,12)	MA1,2	12	.31	.14	2.21				
LAFS13A						.75	.97	.99	.99
D=(1,12)	AR1,1	1	-.38	.13	-2.86				
P=1									
MCS13A						.92	.93	.96	.96
D=(1,12)	MA1,1	1	.33	.14	2.35				
Q=1									

EXHIBIT 3.1

UNIVARIATE TIME SERIES
HSDG COHORT MODEL RESULTS

COHORT	PARAMETER	LAG	ESTIMATE	STD-ERROR	T-RATIO	AUTOCORRELATION CHECK OF RESIDUALS TO LAG 6	12	18	24
ARMYD13A						.35	.82	.73	.74
D=(1,12)	AR1,1	1	-.21	.11	-1.91				
	AR1,2	2	-.37	.11	-3.29				
	MA1,2	16	.31	.12	2.57				
NAVYD13A						.53	.71	.30	.50
D=(1,12)	MA1,1	2	.34	.12	2.85				
	MA2,1	12	.57	.11	5.05				
AFD13A						.06	.66	.86	.79
	MU	0	2463.00	139.00	17.60				
	AR1,1	1	.24	.15	1.60				
	MA1,1	1	-.60	.12	-4.97				
	MA2,1	6	-.41	.12	-3.36				
	MA3,1	12	-.50	.13	-3.78				
LMCD13A						.72	.77	.63	.90
D=(1,12)	AR1,1	1	-.33	.12	-2.83				
	AR1,2	2	-.33	.12	-2.83				
	MA1,1	12	.34	.13	2.54				
	MA2,1	24	.32	.15	2.21				

2. Univariate Model Results

Exhibits 3.1 and 3.2 summarize the estimation results for the HSDG and HSSR cohorts by Service. In the HSDG modeling, first and twelfth differences (indicated by D = (1,12)) were taken for the Army, Navy, and Marine Corps to produce stationary series. In addition, the Marine Corps series was transformed to logarithms to reduce heteroscedasticity. The best specification turned out to be somewhat different for each Service; for example, for the Marine Corps, a second order autoregressive model with multiplicative seasonal moving average lags at 12 and 24 was found to fit well. With regard to the HSSR cohort modeling, first and twelfth differences were taken for all the Services, while only for the Marine Corps was heteroscedasticity not a potential problem. Goodness of fit is evaluated by probabilities measuring the likelihood of randomness of the residual series; these are reported for four lengths of lags under autocorrelation check of residuals.[2] The estimated models are summarized in equation form in Exhibit 3.3

As a way of assessing and comparing the usefulness of these models as monitoring tools, the standard errors of the estimate statistics are reported in Exhibit 3.4 (see the Univariate column). (The underlying monthly predictions are shown by Service in Exhibits 3.5a-h for the HSDG and HSSR cohorts.) The SEE statistics can be interpreted as the average within-sample prediction error (or as the average percentage error for the logarithmic models). The magnitude of the SEE for the level models can be evaluated relative to the mean of the series.

For the level HSDG models, the Army and Navy average errors are relatively smaller than those for the Air Force. The average percentage error for the Marine Corps is in-between. With regard to

2 Known as Box and Pierce Q-statistic.

where $B^jX_t = X_{t-j}$. This operator and corresponding notation is a convenient way of expressing models that easily become complex, especially when seasonal processes are identified and incorporated.

The Box-Jenkins procedure for fitting an ARMA (p,q) model to a time series consists of three stages: identification, estimation and testing, and application. In the identification stage, the first step is to obtain a stationary series, otherwise spurious autocorrelations that have been introduced by trend will hinder identification. Typically, by taking a first difference a series can be made stationary. The second step is to examine the autocorrelations and partial autocorrelations. (Autocorrelation measures the relationship between current values of the series and past values at specific lags. Partial autocorrelation measures this relationship and also holds constant the effects of lags other than the one in question.)

From this examination, one determines the process (AR, MA, or mixed) and the appropriate order. Identification requires judgement to deal with the possibility that the direct and partial autocorrelations may not clearly indicate a specific model, or that they may indicate more than one model. Thus, one infers a tentative model, and proceeds to estimate and test it.

In the estimation and testing stage, the goodness of fit is determined by the statistical significance of the estimated parameters and the extent to which the estimated model has removed the autororrelation patterns in the time series and left white noise. The latter is measured by calculation of autocorrelation for the residual time series. The model can be tested by evaluating the one-period-ahead forecasts, by forecasting several periods ahead, and by forecasting for the out-of-sample period.

EXHIBIT 3.0

SUMMARY OF AR AND MA MODELS

AR PROCESS	MA PROCESS
o X_t is a linear combination of p past values and e_t	o X_t is a linear combination of q past error terms and e_t
o The process weights past errors in an exponentially decreasing manner	o The process weights past values of X_t in an exponentially decreasing manner

models (but having nothing to do with moving averages) -- can be utilized to model series that cannot be isolated with an AR(p) model. The MA model expresses X_t as a linear combination of past errors:

$$(4) \qquad X_t = e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} \cdots - \theta_q e_{t-q}$$

The appropriate order q is determined empirically; an MA(1) model appears as:

$$(5) \qquad X_t = e_t - \theta_1 e_{t-1}$$

If this is not intuitively appealing, substitution for the error terms in (5) indicates that X_t can also be expressed as a function of all its past values, weighted in a decreasing manner. Exhibit 3.0 summarizes the models underlying the AR and MA processes.

The AR and MA processes can be combined as an ARMA (p, q) process of the form:

$$(6) \qquad X_t = \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + \cdots \varphi_p X_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} \cdots - \theta_q e_{t-q}$$

An ARMA (2, 1) model appears as:

$$(7) \qquad X_t = \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + e_t - \theta_1 e_{t-1}$$

Rewriting, we have:

$$(8) \qquad X_t - \varphi_1 X_{t-1} - \varphi_2 X_{t-2} = e_t - \theta_1 e_{t-1}$$

By making use of a the backshift operator B, the above equation can be expressed as:

$$(9) \qquad (1 - \varphi_1 B^1 - \varphi_2 B^2) X_t = (1 - \theta_1 B^1) e_t$$

examined in the Chapter V.) Analyses of HSDG's, HSSR's, and the combination of the two are described. For the Army and Navy, the focus is upon 1-3A cohorts, and for the Air Force and Marine Corps, 1-3 cohorts are analyzed.

B. Time-Series Models

1. Overview of Univariate ARMA Models

The general class of autoregressive (AR) models are of the form:

$$(1) \qquad X_t = \varphi X_{t-1} + \varphi_2 X_{t-2} + \varphi_3 X_{t-3} + \ldots \varphi_p X_{t-p} + e_t$$

to indicate that X_t is a function only of its past values and random noise (error). Substitution into the X_{t-i} terms of equation (1) indicates that the AR process weights past errors in an exponentially decreasing manner. The appropriate number of previous values is the order of the equation and is determined empirically. First (p=1) and second order (p=2) equations appear as:

$$(2) \qquad X_t = \varphi_1 X_{t-1} + e_t$$

$$(3) \qquad X_t = \varphi_1 X_{t-1} + \varphi_2 X_{t-2} + e_t$$

In applying an AR(2) model, for example, the values of the autoregressive parameters φ_1 and φ_2 are estimated as those that make the mean square error ($MSE = \Sigma e_t^2/n-2$) a minimum. The estimates are obtained using a nonlinear least squares method and the variances are calculated in a way ... takes into account the fact that the right-hand-side variables are correlated with each other.

A complementary class of models -- called moving average (MA)

CHAPTER III

MONITORING CONTRACTS

A. Introduction

The specification and estimation of monthly time-series and regression models of high-quality enlistment cohorts are described and evaluated in this chapter. The aim is to determine how closely current enlistments can be tracked. "Reasonably" narrow confidence intervals, obtained at an acceptable level, e.g., 90 percent, make it possible to detect unexpected shortfalls (as well as oversubscription). With such a capability, monitoring alerts can be sounded as a first signal to look for other indicators of potential difficulty and to examine the model -- especially with reference to changes in the use of policy levers for affecting observed enlistments.

Univariate time-series methods are described and applied to male NPS high-quality HSDG and HSSR cohorts by Service, in the first section of the chapter. This discussion is followed by a description of the specification and estimation of bivariate time-series models in which unemployment is the input variable and enlistments is the output variable. The bivariate modeling is confined to the HSDG cohorts.[1]

The second part of the chapter is devoted to a discussion of our time-series regression analysis. An enlistment pipeline framework is portrayed with the focus upon the estimation of the monthly flow of gross contracts. Those factors believed to affect the application decision and the conversion of applicants to contracts are modeled in a combined fashion. (While the application process is not modeled separately, the potential gain in forecasting accuracy from knowing applicants is

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1 The time-series analyses were undertaken with the guidance of Professor Frank Alt, College of Business and Management, University of Maryland.

the EEWS monthly report. Graphic and tabular presentations of descriptive statistics can be used to evaluate the forecasting models and interpret the forecasts. The models condense information from many sources. The descriptive statistics give decision-makers a view of the separate changes in enlistments and related data. Access to both types of information should lead to better decisions.

EXHIBIT 3.5d

UNIVARIATE TRACKING TESTS
MARINE CORPS 1-3A HSDG NPS MALES
February 1978 - March 1983

FEB78	726.27	1.16605	537.449	981.44	564.10	935.08	685	-41.27
MAR78	729.53	1.16605	539.861	985.84	566.63	939.27	714	-15.53
APR78	535.80	1.16605	396.498	724.05	416.16	689.84	570	34.20
MAY78	503.18	1.16605	372.361	679.97	390.82	647.85	592	88.82
JUN78	795.14	1.16605	588.410	1074.50	617.58	1023.74	957	161.86
JUL78	876.25	1.16605	648.435	1184.11	680.58	1128.17	863	-13.25
AUG78	887.70	1.16605	656.908	1199.58	689.48	1142.92	797	-90.70
SEP78	569.51	1.16605	421.439	769.59	442.33	733.24	645	75.49
OCT78	599.07	1.16605	443.317	809.54	465.30	771.30	471	-128.07
NOV78	621.72	1.16605	460.082	840.16	482.89	800.47	498	-123.72
DEC78	547.78	1.16605	405.360	740.23	425.46	705.26	444	-103.78
JAN79	547.59	1.16605	405.224	739.98	425.32	705.03	618	70.41
FEB79	546.47	1.16605	404.395	738.47	424.45	703.58	529	-17.47
MAR79	531.91	1.16605	393.620	718.79	413.14	684.84	347	-184.91
APR79	335.66	1.16605	248.393	453.59	260.71	432.16	433	97.34
MAY79	435.24	1.16605	322.081	588.15	338.05	560.37	626	190.76
JUN79	718.44	1.16605	531.655	970.86	558.01	925.00	772	53.56
JUL79	690.33	1.16605	510.853	932.87	536.18	888.80	851	160.67
AUG79	846.10	1.16605	626.120	1143.36	657.16	1089.35	842	-4.10
SEP79	597.50	1.16605	442.158	807.43	464.08	769.29	685	87.50
OCT79	531.63	1.16605	393.410	718.42	412.91	684.47	616	84.37
NOV79	653.36	1.16605	483.490	882.90	507.46	841.20	660	6.64
DEC79	585.55	1.16605	433.313	791.27	454.80	753.90	581	-4.55
JAN80	786.03	1.16605	581.670	1062.19	610.51	1012.01	866	79.97
FEB80	755.70	1.16605	559.225	1021.20	586.95	972.96	875	119.30
MAR80	614.53	1.16605	454.758	830.44	477.30	791.21	646	31.47
APR80	661.13	1.16605	489.242	893.41	513.50	851.20	605	-56.13
MAY80	794.98	1.16605	588.290	1074.23	617.46	1023.53	674	-120.98
JUN80	952.32	1.16605	704.724	1286.91	739.66	1226.11	1064	111.68
JUL80	1120.93	1.16605	829.502	1514.76	870.63	1443.20	1274	153.07
AUG80	1165.69	1.16605	862.625	1575.24	905.39	1500.83	1079	-86.69
SEP80	838.61	1.16605	620.578	1133.24	651.35	1079.71	938	99.39
OCT80	907.72	1.16605	671.718	1226.63	705.02	1168.68	757	-150.72
NOV80	890.09	1.16605	658.675	1202.81	691.33	1145.99	688	-202.09
DEC80	726.89	1.16605	537.908	982.28	564.58	935.88	662	-64.89
JAN81	958.38	1.16605	709.208	1295.09	744.37	1233.91	883	-75.38
FEB81	870.63	1.16605	644.275	1176.51	676.22	1120.94	991	120.37
MAR81	833.32	1.16605	616.664	1126.09	647.24	1072.90	859	25.68
APR81	703.59	1.16605	520.664	950.79	546.48	905.87	692	-11.59
MAY81	742.26	1.16605	549.280	1003.04	576.51	955.66	611	-131.26
JUN81	1082.81	1.16605	801.289	1463.24	841.02	1394.12	1204	121.19
JUL81	1314.30	1.16605	972.594	1776.06	1020.81	1692.16	1307	-7.30
AUG81	1084.01	1.16605	802.177	1464.86	841.95	1395.66	1117	32.99
SEP81	950.21	1.16605	703.17	1284.06	738.03	1223.40	1059	108.79
OCT81	823.71	1.16605	609.55	1113.11	639.78	1060.53	859	35.29
NOV81	807.61	1.16605	597.64	1091.35	627.27	1039.80	718	-89.61
DEC81	727.61	1.16605	538.44	983.24	565.13	936.80	791	63.39
JAN82	1055.77	1.16605	781.28	1426.70	820.01	1359.30	982	-73.77
FEB82	992.27	1.16605	734.29	1340.89	770.69	1277.54	857	-135.27
MAR82	791.39	1.16605	585.64	1069.43	614.67	1018.92	903	111.61
APR82	798.33	1.16605	590.77	1078.81	620.06	1027.85	711	-87.33
MAY82	692.16	1.16605	512.21	935.35	537.60	891.16	774	81.84
JUN82	1351.97	1.16605	1000.47	1826.97	1050.08	1740.66	1313	-38.97
JUL82	1383.77	1.16605	1024.00	1869.93	1074.77	1781.60	1392	8.23
AUG82	1302.99	1.16605	964.22	1760.77	1012.03	1677.60	1372	69.01
SEP82	1189.09	1.16605	879.94	1606.86	923.57	1530.96	1343	153.91
OCT82	1093.22	1.16605	808.99	1477.30	849.10	1407.52	937	-156.22
NOV82	933.53	1.16605	690.82	1261.51	725.07	1201.92	1204	270.47
DEC82	1211.05	1.16605	896.19	1636.53	940.62	1559.23	987	-224.05
JAN83	1246.83	1.16605	922.67	1684.88	968.41	1605.29	1334	87.17
FEB83	1303.93	1.16605	964.92	1762.05	1012.76	1678.82	1049	-254.93
MAR83	1073.21	1.16605	794.18	1450.26	833.56	1381.75	955	-118.21

EXHIBIT 3.5e

UNIVARIATE TRACKING TESTS
ARMY 1-3A HSSR NPS MALES
December 1979 - March 1983

DATE	FCAST	SE	L95	U95	L90	U90	ACTUAL	RESID
NOV78	.	.	.	.	.	.	446	.
DEC78	.	.	.	.	.	.	570	.
JAN79	.	.	.	.	.	.	611	.
FEB79	.	.	.	.	.	.	519	.
MAR79	.	.	.	.	.	.	458	.
APR79	.	.	.	.	.	.	382	.
MAY79	.	.	.	.	.	.	413	.
JUN79	.	.	.	.	.	.	335	.
JUL79	.	.	.	.	.	.	371	.
AUG79	.	.	.	.	.	.	380	.
SEP79	.	.	.	.	.	.	294	.
OCT79	.	.	.	.	.	.	385	.
NOV79	.	.	.	.	.	.	477	.
DEC79	619.62	1.14591	474.44	809.21	495.24	775.23	484	-135.62
JAN80	523.12	1.14591	400.56	683.19	418.12	654.50	565	41.88
FEB80	499.13	1.14591	382.18	651.85	398.94	624.48	555	55.87
MAR80	545.21	1.14591	417.47	712.04	435.77	682.13	742	196.79
APR80	594.83	1.14591	455.46	776.83	475.43	744.21	705	110.17
MAY80	712.43	1.14591	545.51	930.42	569.43	891.35	577	-135.43
JUN80	385.86	1.14591	295.45	503.92	308.40	482.76	341	-44.86
JUL80	355.46	1.14591	272.17	464.22	284.11	444.72	434	78.54
AUG80	505.93	1.14591	387.39	660.73	404.37	632.98	440	-65.93
SEP80	394.39	1.14591	301.99	515.07	315.22	493.44	455	60.61
OCT80	558.54	1.14591	427.67	729.44	446.42	698.81	659	100.46
NOV80	820.37	1.14591	628.16	1071.39	655.70	1026.40	807	-13.37
DEC80	810.67	1.14591	620.74	1058.72	647.95	1014.26	903	92.33
JAN81	967.51	1.14591	740.83	1263.55	773.30	1210.49	838	-129.51
FEB81	784.45	1.14591	600.65	1024.48	626.99	981.45	834	49.55
MAR81	911.83	1.14591	698.19	1190.83	728.80	1140.82	924	12.17
APR81	896.36	1.14591	686.35	1170.63	716.43	1121.47	872	-24.36
MAY81	789.09	1.14591	604.21	1030.54	630.70	987.26	684	-105.09
JUN81	469.54	1.14591	359.53	613.22	375.29	587.46	536	66.46
JUL81	618.67	1.14591	473.72	807.98	494.49	774.05	607	-11.67
AUG81	673.53	1.14591	515.73	879.62	538.34	842.68	568	-105.53
SEP81	479.29	1.14591	366.99	625.94	383.08	599.65	579	99.71
OCT81	814.38	1.14591	623.58	1063.57	650.91	1018.90	746	-68.38
NOV81	956.11	1.14591	732.10	1248.66	764.19	1196.22	1005	48.89
DEC81	1072.03	1.14591	820.86	1400.06	856.85	1341.26	1142	69.97
JAN82	1203.29	1.14591	921.36	1571.47	961.75	1505.48	1201	-2.29
FEB82	1108.58	1.14591	848.84	1447.79	886.06	1386.98	1368	259.42
MAR82	1494.77	1.14591	1144.56	1952.15	1194.73	1870.17	1583	88.23
APR82	1429.31	1.14591	1094.43	1866.65	1142.41	1788.26	1640	210.69
MAY82	1298.67	1.14591	994.40	1696.04	1037.99	1624.82	1270	-28.67
JUN82	912.20	1.14591	698.48	1191.32	729.09	1141.29	1066	153.80
JUL82	1167.16	1.14591	893.70	1524.29	932.88	1460.28	1027	-140.16
AUG82	1053.69	1.14591	806.82	1376.11	842.19	1318.32	1248	194.31
SEP82	1119.97	1.14591	857.56	1462.66	895.16	1401.23	1010	-109.97
OCT82	1466.41	1.14591	1122.84	1915.11	1172.06	1834.68	1297	-169.41
NOV82	1508.98	1.14591	1155.43	1970.71	1206.09	1887.94	1568	59.02
DEC82	1921.11	1.14591	1471.00	2508.94	1535.49	2403.57	1914	-7.11
JAN83	2017.93	1.14591	1545.14	2635.39	1612.88	2524.71	1901	-116.93
FEB83	2047.58	1.14591	1567.84	2674.11	1636.57	2561.81	1936	-111.58
MAR83	2105.07	1.14591	1611.86	2749.19	1682.52	2633.73	2142	36.93

EXHIBIT 3.5f

UNIVARIATE TRACKING TESTS
NAVY 1-3A HSSR NPS MALES
December 1979 - March 1983

DATE	FCAST	SE	L95	U95	L90	U90	ACTUAL	RESID
NOV78	.	.	.	.	.	.	248	.
DEC78	.	.	.	.	.	.	453	.
JAN79	.	.	.	.	.	.	573	.
FEB79	.	.	.	.	.	.	600	.
MAR79	.	.	.	.	.	.	575	.
APR79	.	.	.	.	.	.	515	.
MAY79	.	.	.	.	.	.	507	.
JUN79	.	.	.	.	.	.	352	.
JUL79	.	.	.	.	.	.	316	.
AUG79	.	.	.	.	.	.	369	.
SEP79	.	.	.	.	.	.	361	.
OCT79	.	.	.	.	.	.	533	.
NOV79	.	.	.	.	.	.	632	.
DEC79	1154.42	1.17006	848.55	1570.54	891.59	1494.73	757	-397.42
JAN80	957.53	1.17006	703.83	1302.68	739.52	1239.80	941	-16.53
FEB80	985.34	1.17006	724.27	1340.51	761.00	1275.81	1015	29.66
MAR80	972.71	1.17006	714.99	1323.33	751.25	1259.45	1079	106.29
APR80	966.41	1.17006	710.36	1314.76	746.38	1251.30	974	7.59
MAY80	958.87	1.17006	704.81	1304.50	740.56	1241.54	661	-297.87
JUN80	501.77	1.17006	368.82	682.63	387.53	649.68	589	87.23
JUL80	530.71	1.17006	390.10	722.01	409.88	687.16	646	115.29
AUG80	749.63	1.17006	551.01	1019.84	578.96	970.62	627	-122.63
SEP80	600.10	1.17006	441.10	816.41	463.47	777.00	703	102.90
OCT80	1036.23	1.17006	761.68	1409.75	800.31	1341.70	783	-253.23
NOV80	1004.45	1.17006	738.31	1366.50	775.76	1300.55	910	-94.45
DEC80	1183.19	1.17006	869.70	1609.68	913.81	1531.99	1076	-107.19
JAN81	1289.21	1.17006	947.63	1753.92	995.69	1669.26	972	-317.21
FEB81	1079.98	1.17006	793.83	1469.26	834.09	1398.34	1156	76.02
MAR81	1155.04	1.17006	849.01	1571.38	892.07	1495.54	1234	78.96
APR81	1179.40	1.17006	866.91	1604.52	910.88	1527.08	1111	-68.40
MAY81	852.75	1.17006	626.81	1160.13	658.60	1104.14	790	-62.75
JUN81	687.28	1.17006	505.19	935.02	530.81	889.89	665	-22.28
JUL81	733.54	1.17006	539.19	997.95	566.53	949.78	592	-141.54
AUG81	594.87	1.17006	437.26	809.30	459.44	770.24	652	57.13
SEP81	690.20	1.17006	507.33	938.98	533.06	893.66	707	16.80
OCT81	861.30	1.17006	633.10	1171.76	665.20	1115.21	706	-155.30
NOV81	856.82	1.17006	629.80	1165.67	661.75	1109.41	904	47.18
DEC81	1104.84	1.17006	812.11	1503.09	853.30	1430.54	1141	36.16
JAN82	1165.57	1.17006	856.75	1585.71	900.20	1509.17	1188	22.43
FEB82	1360.08	1.17006	999.73	1850.34	1050.43	1761.03	1290	-70.08
MAR82	1345.38	1.17006	988.92	1830.34	1039.07	1741.99	1469	123.62
APR82	1402.22	1.17006	1030.70	1907.66	1082.97	1815.58	1434	31.78
MAY82	1029.58	1.17006	756.79	1400.70	795.17	1333.09	1085	55.42
JUN82	915.38	1.17006	672.84	1245.33	706.97	1185.22	936	20.62
JUL82	880.26	1.17006	647.03	1197.55	679.84	1139.75	796	-84.26
AUG82	864.48	1.17006	635.44	1176.09	667.66	1119.32	927	62.52
SEP82	980.18	1.17006	720.48	1333.49	757.02	1269.13	778	-202.18
OCT82	816.65	1.17006	600.27	1111.01	630.72	1057.39	1034	217.35
NOV82	1290.24	1.17006	948.39	1755.32	996.49	1670.59	1388	97.76
DEC82	1728.29	1.17006	1270.38	2351.27	1334.80	2237.78	1494	-234.29
JAN83	1580.70	1.17006	1161.89	2150.48	1220.82	2046.68	1345	-235.70
FEB83	1460.14	1.17006	1073.27	1986.46	1127.70	1890.58	1433	-27.14
MAR83	1672.67	1.17006	1229.49	2275.59	1291.84	2165.76	1623	-49.67

EXHIBIT 3.5g

UNIVARIATE TRACKING TESTS
AIR FORCE 1-3AHSSR NPS MALES
December 1979 - March 1983

DATE	FCAST	SE	L95	U95	L90	U90	ACTUAL	RESID
NOV78	.	.	.	.	.	.	216	.
DEC78	.	.	.	.	.	.	359	.
JAN79	.	.	.	.	.	.	376	.
FEB79	.	.	.	.	.	.	458	.
MAR79	.	.	.	.	.	.	393	.
APR79	.	.	.	.	.	.	403	.
MAY79	.	.	.	.	.	.	394	.
JUN79	.	.	.	.	.	.	224	.
JUL79	.	.	.	.	.	.	202	.
AUG79	.	.	.	.	.	.	247	.
SEP79	.	.	.	.	.	.	196	.
OCT79	.	.	.	.	.	.	325	.
NOV79	.	.	.	.	.	.	474	.
DEC79	773.06	1.15821	579.680	1030.96	607.130	984.35	512	-261.06
JAN80	586.88	1.15821	440.070	782.66	460.909	747.28	602	15.12
FEB80	715.74	1.15821	536.698	954.52	562.113	911.36	746	30.26
MAR80	637.83	1.15821	478.274	850.61	500.922	812.15	750	112.17
APR80	743.99	1.15821	557.883	992.19	584.301	947.33	712	-31.99
MAY80	707.43	1.15821	530.466	943.43	555.586	900.78	630	-77.43
JUN80	365.73	1.15821	274.245	487.74	287.231	465.69	467	101.27
JUL80	398.38	1.15821	298.723	531.28	312.869	507.26	372	-26.38
AUG80	466.84	1.15821	350.060	622.58	366.637	594.43	375	-91.84
SEP80	309.85	1.15821	232.339	413.21	243.341	394.53	386	76.15
OCT80	606.12	1.15821	454.495	808.32	476.017	771.77	491	-115.[illegible]
NOV80	756.98	1.15821	567.618	1009.51	594.497	963.86	676	-80.9[illegible]
DEC80	739.06	1.15821	554.182	985.61	580.425	941.05	839	99.94
JAN81	958.20	1.15821	718.508	1277.86	752.532	1220.09	778	-180.20
FEB81	1013.24	1.15821	759.773	1351.25	795.752	1290.16	907	-106.24
MAR81	923.59	1.15821	692.556	1231.71	725.351	1176.02	1026	102.41
APR81	950.26	1.15821	712.551	1267.27	746.293	1209.97	979	28.74
MAY81	865.32	1.15821	648.862	1154.00	679.589	1101.82	714	-151.32
JUN81	551.13	1.15821	413.261	734.98	432.830	701.75	584	32.87
JUL81	455.71	1.15821	341.715	607.74	357.897	580.26	498	42.29
AUG81	494.91	1.15821	371.104	660.01	388.677	630.17	518	23.09
SEP81	529.71	1.15821	397.200	706.42	416.009	674.48	510	-19.71
OCT81	654.80	1.15821	491.001	873.24	514.252	833.76	540	-114.80
NOV81	772.57	1.15821	579.314	1030.31	606.746	983.72	750	-22.57
DEC81	929.14	1.15821	696.713	1239.10	729.705	1183.08	1005	75.86
JAN82	917.09	1.15821	687.681	1223.04	720.246	1167.74	919	1.91
FEB82	1074.52	1.15821	805.726	1432.98	843.880	1368.19	882	-192.52
MAR82	1039.19	1.15821	779.236	1385.87	816.136	1323.21	983	-56.19
APR82	940.89	1.15821	705.527	1254.78	738.937	1198.05	862	-78.89
MAY82	639.89	1.15821	479.818	853.35	502.539	814.77	736	96.11
JUN82	582.45	1.15821	436.750	776.76	457.432	741.64	542	-40.45
JUL82	472.46	1.15821	354.271	630.07	371.047	601.58	367	-105.46
AUG82	400.62	1.15821	300.406	534.27	314.632	510.12	314	-86.62
SEP82	322.06	1.15821	241.494	429.50	252.930	410.08	325	2.94
OCT82	340.53	1.15821	255.349	454.14	267.441	433.60	353	12.47
NOV82	487.67	1.15821	365.678	650.36	382.994	620.95	520	32.33
DEC82	688.27	1.15821	516.095	917.87	540.534	876.37	737	48.73
JAN83	666.07	1.15821	499.448	888.27	523.099	848.10	689	22.93
FEB83	658.21	1.15821	493.555	877.79	516.927	838.10	672	13.79
MAR83	746.43	1.15821	559.710	995.44	586.214	950.43	800	53.57

EXHIBIT 3.5h

UNIVARIATE TRACKING TESTS
MARINE CORPS 1-3A HSSR NPS MALES
December 1979 - March 1983

FORECASTS FOR VARIABLE MCS13A

	OBS	FORECAST	STD ERROR	LOWER 95%	UPPER 95%	ACTUAL	RESIDUAL
7912	14	435.0000	61.8169	313.8413	556.1587	358.0000	-77.0000
	15	373.7784	61.8169	252.6197	494.9372	372.0000	-1.7784
	16	371.0342	61.8169	249.8755	492.1930	391.0000	19.9658
	17	334.3891	61.8169	213.2304	455.5479	366.0000	31.6109
	18	358.6171	61.8169	237.4584	479.7758	342.0000	-16.6171
	19	357.6635	61.8169	236.5047	478.8222	292.0000	-65.6635
	20	291.1858	61.8169	170.0271	412.3445	281.0000	-10.1858
	21	348.9234	61.8169	227.7647	470.0822	356.0000	7.0766
	22	341.8847	61.8169	220.7260	463.0434	380.0000	38.1153
	23	367.8345	61.8169	246.6758	488.9932	441.0000	73.1655
8010	24	542.4515	61.8169	421.2928	663.6102	551.0000	8.5485
	25	519.0287	61.8169	397.8700	640.1874	525.0000	5.9713
	26	495.5275	61.8169	374.3687	616.6862	489.0000	-6.5275
	27	506.7960	61.8169	385.6372	627.9547	515.0000	8.2040
	28	529.2290	61.8169	408.0703	650.3878	540.0000	10.7710
	29	508.7363	61.8169	387.5776	629.8950	590.0000	81.2637
	30	518.7421	61.8169	397.5833	639.9008	521.0000	2.2579
	31	469.6869	61.8169	348.5282	590.8456	375.0000	-94.6869
	32	419.0640	61.8169	297.9053	540.2228	540.0000	120.9360
	33	544.6711	61.8169	423.5124	665.8299	589.0000	44.3289
	34	587.2211	61.8169	466.0624	708.3798	519.0000	-68.2211
	35	619.6732	61.8169	498.5144	740.8319	509.0000	-110.6732
8110	36	683.3606	61.8169	562.2019	804.5194	600.0000	-83.3606
	37	622.4774	61.8169	501.3187	743.6361	635.0000	12.5226
	38	591.7176	61.8169	470.5589	712.8764	667.0000	75.2824
	39	649.2204	61.8169	528.0617	770.3792	579.0000	-70.2204
	40	644.8359	61.8169	523.6771	765.9946	632.0000	-12.8359
	41	689.4645	61.8169	568.3058	810.6233	644.0000	-45.4645
	42	601.4394	61.8169	480.2806	722.5981	501.0000	-100.4394
	43	413.4093	61.8169	292.2506	534.5680	465.0000	51.5907
	44	599.9980	61.8169	478.8393	721.1568	728.0000	128.0020
	45	702.5620	61.8169	581.4033	823.7207	663.0000	-39.5620
	46	616.0068	61.8169	494.8481	737.1655	647.0000	30.9932
	47	618.9763	61.8169	497.8176	740.1350	626.0000	7.0237
8210	48	712.9154	61.8169	591.7567	834.0742	774.0000	61.0846
	49	773.4770	61.8169	652.3183	894.6357	817.0000	43.5230
	50	823.6897	61.8169	702.5310	944.8484	834.0000	10.3103
	51	740.0042	61.8169	618.8455	861.1629	892.0000	151.9958
	52	856.6086	61.8169	735.4499	977.7674	847.0000	-9.6086
8303	53	864.5878	61.8169	743.4291	985.7465	878.0000	13.4122

the HSSR models, the errors for the four Services are approximately the same.

3. Overview of Bivariate Models[3]

The two variable time-series model, from the class of multivariate ARMA models, is given by:

$$(10) \qquad Y_t - \delta_1 Y_{t-1} - \delta_2 Y_{t-2} --- \delta_t Y_{t-r} = W_o X_{t-b} - W_1 X_{t-b-1} --- -W_s X_{t-b-s} + e_t.$$

Y_t is the dependent or output variable (e.g. enlistments) whose future values are to be predicted. X_t is the independent variable and frequently is called the input series or the leading indicator because it leads the dependent variable by b time lags. The parameter b measures the lead of X_t to Y_t. If $b>o$, X_t is a leading indicator and can be used to forecast Y_t; if $b=o$, X_t is of little value in forecasting since it is not known beforehand; and if $b<o$, Y_t is the leading indicator and thus X_t will be of no value in forecasting Y_t. A mental rearrangment of (10) with only Y_t on the left-hand side would express a relationship between the output variable as a function of a to-be-determined number of its past time lags as well as (hopefully) past time lags of the input variable and random error.

The procedure for forecasting with a bivariate ARMA model follows the same identification, estimation and testing, and application stages. The major difficulty is in identification: the steps necessary to specify b, r, s, and a noise model for e_t are complicated because Y_t and X_t are themselves generated by univariate processes that must be modeled.

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3 Discussion is based on Chapter 11 of Makridakis, S., Wheelwright, S. C., Forecasting Methods and Applications, John Wiley &Sons, New York, 1978.

In order to clarify the sources and types of variation within the bivariate model (10), suppose we consider a b=3, r=1, s=1 model:

(11) $Y_t = \delta_1 Y_{t-1} + W_o X_{t-3} - W_1 X_{t-4} + e_t$

Assume that the underlying univariate processes for X_t and Y_t are both AR(2):

(12) $Y_t = \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + e_t$

(13) $X_t + \varphi'_1 X{-1} + \varphi'_2 X_{t-2} + e_t$

Taking the appropriate lags, these equations can be substituted into (11) to yield the output model:

(14)
$$\begin{aligned} Y_t = {} & \delta_1(\varphi_1 Y_{t-2} + \varphi_2 Y_{t-3} + e_{t-1}) \\ & + w_o(\varphi'_1 X_{t-4} + \varphi'_2 X_{t-5} + e_{t-3}) \\ & - w_1(\varphi'_1 X_{t-5} + \varphi'_2 X_{t-6} + e_{t-4}) + e_t \end{aligned}$$

For this illustration X_t includes only one type of variation in its ARMA generating process (13), but Y_t includes variation caused by its own generating process (12); by the process for X_t (13); and by the joint Y_t with X_{t-b} process (11). Unless these three patterns can be separated, there is little that can be done to identify the generating process of (14):

> " In some sense the joint relationship of Y_t and X_t is buried within the Y_t and X_t variation and cannot be discovered unless all other types of variations, except that between Y_t and X_t variation, have been eliminated. To eliminate the variations within Y_t and within X_t, the two series must be prewhitened by manipulating them until the variation within each of them has been eliminated as far as possible.[4]

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4 Ibid, p.387

Thus the identification stage is preceeded by a prewhitening stage to eliminate any spurious correlation between the input and output series. Y_t is filtered by the X_t univariate process. Note that if X_t is to be a good leading indicator of Y_t, there should be similarity between their univariate processess. The next step is to identify a tentative relationship between the prewhitened Y_t and X_t series by examining their cross autocorrelations.[5]

The examination is facilitated by these rules of thumb:

1. For K time lags ($k < b$), the cross autos will not be significantly different from zero. Thus, b is identified as the time lag corresponding to the first significant cross auto.

2. For s time lags, the cross autos will not show a clear pattern, even though they well may be significant. The value of s is inferred from the difference between b and the point at which the pattern of the cross autos starts. Thus, if $b = 3$ and the pattern of cross autos commences at 5, $s = 2$.

3. The value of r is identified by examining the pattern of cross autos after time lag $b + s$ and inferring the order of AR(r) process that has generated this pattern.[6]

In the next step the parameters of (10) are estimated.[7] This is followed by examination of the autocorrelation of the residuals in order to specify a noise model for (14). Finally, the complete model is estimated. The entire process is summarized in Exhibit 3.6.

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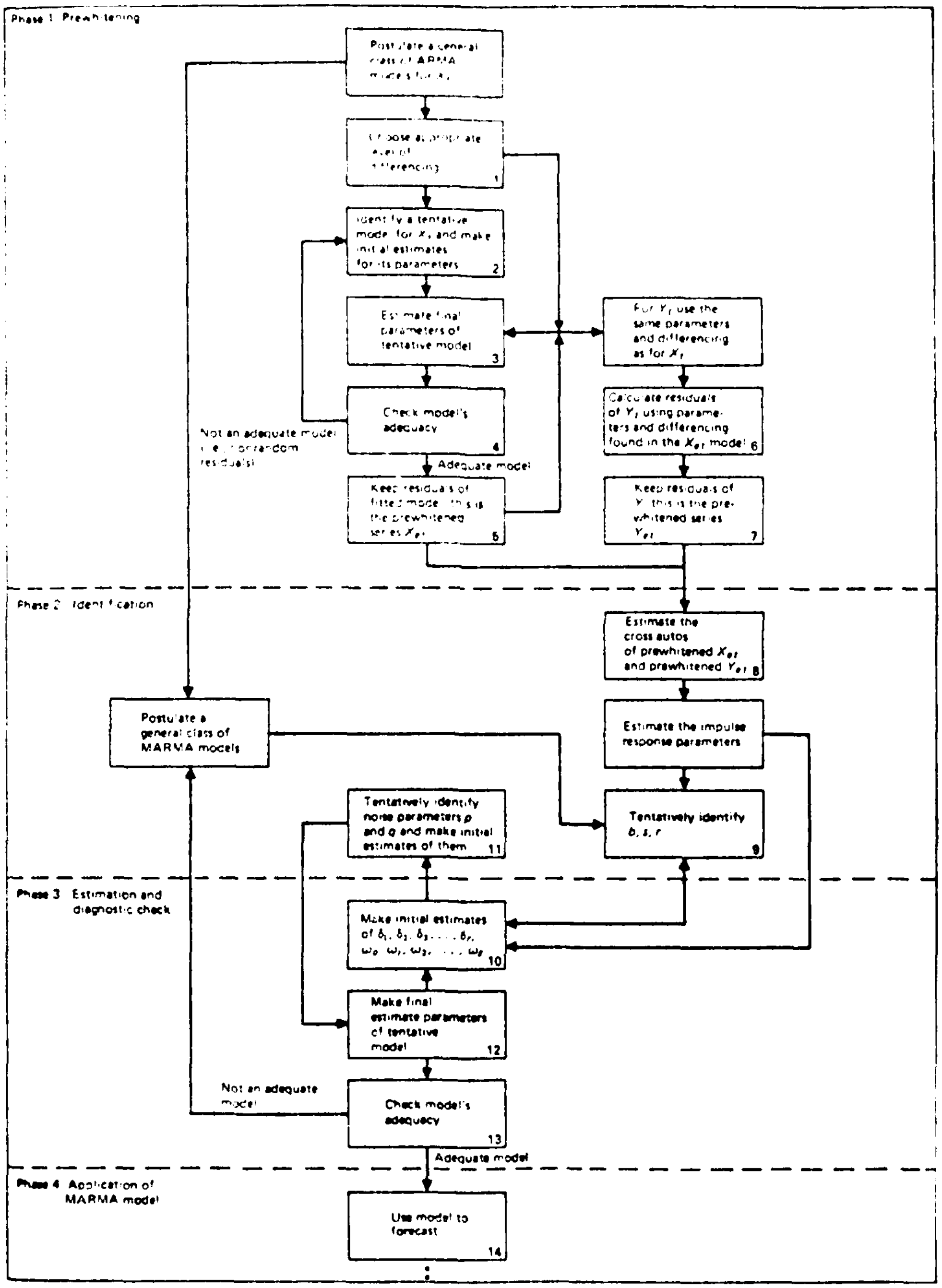
5 Ibid, p. 377

6 Ibid, p. 387

7 See Makridakis and Wheelwright pp. 387-391 for a discussion of the relationship between the estimation parameters, the cross autos, and the variances of the prewhitened series.

EXHIBIT 3.6

THE BASIC STEPS IN DEVELOPING A MARMA MODEL



SOURCE: Makridakis, S., Wheelwright, S.C., Forecasting Methods and Applications, John Wiley & Sons, New York, 1978, p.385.

4. Bivariate Models Results

For this study, bivariate models were estimated with unemployment as the input and HSDG enlistment contracts as the output variable. The objective was to determine if unemployment is useful as a leading indicator of contracts; that is, is there information in past values of unemployment which is not already contained in the univariate model of enlistment contracts.

Following the steps outlined above, the contract and unemployment series were first prewhitened by the univariate filters described in Chapter IV, and the two series were cross correlated. The estimated cross correlations are not particularily strong (see Exhibit 3.7). They indicate some relationship at lag 2 for the Army, Navy, and Marine Corps, and perhaps at lag 1 for the Air Force. Next, b, s, and r parameter values were selected and the model was estimated. Finally, based on the autocorrelation of the residuals, a noise model was specified and a final model was estimated. They are shown in Exhibits 3.8 and 3.9.

The bivariate models appear to do no better than the univariate model in monitoring enlistments (see Exhibit 3.4). In fact, the bivariate standard errors of the estimate tend to be larger than the univariate errors.

What should be inferred about the absence of a relationship between enlistment and unemployment in the bivariate time-series modeling? After removal from each series of autocorrelation and any joint spurious correlation between them, we did not find a strong relationship between the two (when other factors are not held constant). Apparently unemployment is neither causally prior to nor a leading indicator, in the time-series sense of embodying information not already present in the enlistment time

EXHIBIT 3.7

HSDG BIVARIATE MODELS: CROSSCORRELATION WITH UNEMPLOYMENT RATE

WITH ALLUNEMP(1)[a]

COHORT SERIES	0	1	2	3	4	5	6
ARMYD13A (1, 12)	-.19	.00	.20	.05	-.14	.10	-.10
NAVYD13A (1, 12)	.01	.06	.15	.01	-.18	.07	-.11
AFD13A (1)	.07	.19	.05	.01	-.06	-.19	-.06
LMCD13A	-.06	-.05	.24**	-.17	-.08	.17	-.14

WITH YTHUNEMP(1)[b]

COHORT SERIES	0	1	2	3	4	5	6
ARMYD13A (1, 12)	-.01	.15	.25**	.08	-.08	.03	-.06
NAVYD13A (1, 12)	-.01	.14	.25**	-.05	-.13	-.02	-.06
LMCD13A (1, 12)	-.16	.00	.22**	-.22**	.03	.07	-.05

** Statistically significant at .o5 level or better

a Contract and unemployment series were prewhitened by the ALLUNEMP(1) Univariate filter:

$$(1 - B)(1 - .87B^1)U_t = (1 - .59B^1)(1 - .35B^{12})(1 - .33B^{24})e_t$$

b Prewhitening accomplished by the YTHUNEMP(1) filter:

$$(1 - B)U_t = (1 - .18B)(1 - .20B^{12} - .29B^{24})e_t$$

EXHIBIT 3.8

BIVARIATE HSDG 1-3A MODELS WITH ALLUNEMP (D = 1)

SERVICE AND COHORT		AUTOCORRELATION CHECK OF RESIDUALS TO LAG			
		6	12	18	24
ARMYD13A		.41	.87	.55	.75
D = (1,12)	$Y_t = -145U_t + 298^{**}U_{t-2} + N_t$				
b = o, s = 2,	$(1 + .29^{**}B + .32^{**}B^2)N_t = (1 - .21B^{13})e_t$				
r = o					
NAVYD13A		.38	.71	.30	.45
D = (1,12)	$Y_T = 132.7U_{t-2} + N_t$				
b = 2, s = o,	$N_t = (1 - .35^{**}B^2 - .34^{**}B^{12})e_t$				
r = o					
AFD13A		.35	.64	.85	.82
D = (1)	$Y_t = 420^{**}U_{t-1} + N_t$				
b = 1, s = o,	$N_t = e_t$				
r = o					
LMCD13A		.48	.61	.56	.86
D = (1,12)	$LY_t = .06U_{t-2} + N_t$				
b = 2, s = o,	$(1 + .31^{**}B^1 + .33^{**}B^2)N_t =$				
r = o	$(1 - .34^{**}B^{12} - .37^{**}B^{24})e_t$				

** Statistically significant at .05 level or better.

EXHIBIT 3.9

BIVARIATE HSDG 1-3A MODELS WITH YTHUNEMP (D = 1)

SERVICE AND COHORT		AUTOCORRELATION CHECK OF RESIDUALS TO LAG			
		6	12	18	24
ARMYD13A		.55	.85	.82	.91
D = (1,12)	$Y_t = 102.8^{**}U_{t-2} + N_t$				
b = 2, s = 0,	$(1 + .50^{**}B + .44^{**}B^2)N_t = (1 + .14B)(1 - .19B^{13})e_t$				
r = 0					
NAVYD13A		.39	.82	.36	.60
D = (1,12)	$Y_T = 82.7U_{t-2} + N_t$				
b = 2, s = 0,	$N_t = (1 - .26^{**}B^2 - .19B^5 - .24^{*}B^{12})e_t$				
r = 0					
LMCD13A		.78	.57	.75	.74
D = (1,12)	$LY_t = (.05^{**} - .06^{**}B^1)U_{t-2} + N_t$				
b = 2, s = 0,	$(1 + .30^{**}B + .34^{**}B^2)N_t = e_t$				
r = 0					

a A bivariaate relationship was not estimated for the Air Force because of low correlation.

** Statistically significant at .05 level or better.

series.[8] Hence, the bivariate modeling works no better than the univariate modeling. The bivariate methods do indicate, nevertheless, an estimate of the lag in the albeit weak time-series relationship between enlistments and unemployment. This estimate will be utilized in specifying and testing the regression model.

The univariate and bivariate findings confirm a prior suspicion that the enlistment process is not well-modeled with a purely statistical approach.[9] The weak relationship between enlistments and unemployment can be attributed to the restrictive bivariate setting. Enlistments should be modeled using multivariate methods.

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8 According to Granger, causality can be roughly stated as: given two jointly covariance stationary, purely non-deterministic time series U and E, U causes E if the one-step ahead prediction error of E, based on past values of E, is larger than the one-step ahead prediction error of E utilizing past values of U and past values of E. See C. Granger, "Investigating Causal Relations by Econometric Models and Cross Spectral Methods," Econometrica, 1969, vol.37, no. 3, pp.424-438.

9 There is an ongoing discussion in the empirical literature about measuring relationships between time series. Pierce, using time-series modeling procedures, found that numerous economic variables which are generally regarded as being strongly interrelated may be regarded, with equal validity, as only weakly related. Differences between his results and the bulk of econometric literature are attributed to the failure of the latter to satisfactorily account for autocorrelations; see D. Pierce, "Relationships -- and the Lack Thereof -- Between Economic Time Series, With Special Reference to Money and Interest Rates," Journal of the American Statistical Association, March 1977, Vol. 72, no. 357, pp. 11-26. The controversy has been joined by others; see comments that follow Pierce's paper, and references mentioned by G. Wang, "A Study of Economic Indications in Rail Freight Traffic Cycles 1950-76," Transportation Research-B, Vol. 15-B, No. 6-B, p. 397, 1981.

It is important to note the sensitivity of the coefficients (with the exception of the Air Force) to the estimation period. The instability is due to the high intercorrelations and the ways in which they vary with the period, as well as to the "restricted" behavior that is observable within a subperiod.

Estimation of the HSSR models and HSSR plus HSDG models was carried out over the November 1978 to March 1983 period. The results are reported in Exhibits 3.13a-d. The specification employed was the same as that for the HSDG model. The effects of multicollinearity are present once again, and it is difficult to identify separate effects of the variables. While unemployment remains strong, relative pay becomes more prominent during this subperiod in the HSSR models.

Generally speaking, for the combination cohort we find better fits for the Army and Marine Corps, a relatively poor fit for the Air Force, and a fit somewhere in-between for the Navy. We also tested to determine whether knowing the number of applicants at four, five, or six months prior to contracts would improve our capability to explain (and forecast) enlistments. As can be seen in Exhibits 3.13a-d, the inclusion of applicants (labelled as LA6DS13A, LNAP6DS, LAPDS136, and LMAPDS6) does not enter significantly (except for the Army), but drastically affects the other coefficients and substantially reduces the root MSE for the Navy cohort only.

D. Monitoring Feasibility

Because they do not utilize external information, there is little else that can be done to improve the fit of the univariate time-series models we have developed. Virtually all the autocorrelation has been extracted and the standard errors of the estimates are somewhat on the high side -- in the neighborhood of 15 percent -- although in several cases they are better than the corresponding regression models. Given the fluid environment, the inability of a black box statistical technique

unemployment effect. We also find that goals per recruiter -- as a proxy for demand policies and recruiter work effort -- plays an important role. For the Navy and Marine Corps cohorts, apparently the unemployment effect dominates the recruiter and pay effects.[10]

With regard to policy variables, the GI Bill (and spike) dummies are strong in all the Services. In fact, rather high correlation between the GI Bill variable and Navy recruiters led to estimation of several equations for the period beginning April 1977. However, the weak effect for Navy recruiters remained. The Army College Fund (ACF) variable and relative pay are highly correlated. When ACF is excluded, the Army relative pay elasticity doubles.

The binary variable test for the effect of Navy's cessation of Cat. IV's and non HSDG's during the last half of 1983 did not reveal a statistically significant impact.

In addition to the goals variable, we attempted to test for the effects of increases in mental enlistment standards (to G40/C145) and a scarcity of available jobs in the Air Force. We found a reasonable, but not statistically significant impact (SCARCE3) upon enlistments of a scarcity of available jobs relative to goals during the 1977 - 1979 period. On the other hand, it was not possible to determine the extent to which scarcity of jobs played a role above and beyond the low goals during FY 1982 because of multicollinearity (between SCARCE1 and goals-per-recruiter).[11]

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10 One example can be seen in the Navy equation. We created a relative pay variable (LRELMKT) in which civilian earnings are weighted by the likelihood of being employed. This new combination variable is quite strong, whereas relative pay is weak.

11 For the shorter estimation period, a jobs available index can be created.

other lags as well (including no lag), but found somewhat better fits with the "bivariate-indicated" lags. A distributed lag effect of unemployment was examined also: we tested a Koyck model of lags that decline geometrically over time. It did not fit (nor forecast) any better, and since it implies certain econometric complications, we have put it aside for this phase of research. The distributed (over time) effects of unemployment remain as a possible source of the observed autocorrelation among the residuals. Finally, we examined both the all-unemployemnt and youth-unemployment series and obtained somewhat better fits with the former.

The large, simple (negative) correlations between enlistments and population prevailed in the multivariate framework to produce strongly negative partial effects. Given the small amount of variation in the population series and these unreasonable effects, we experimented with excluding it.

The exclusion of population in the Army and Marine Corps models reduced the fit of the equations, while in the Navy and Air Force equations no such reduction occurred. This suggests that for the Army and Marine Corps population may be standing in for other factors, e.g., the Army's targetting of high-quality recruits. (Recall that population itself has a small negative trend and a negative coefficient in the equation, producing a positive effect on enlistments.) Surprisingly, the exclusion of population also strongly improved the forecasting capability -- especially with the Army cohort. Not surprisingly, the relative pay and unemployment effects were boosted. Its effect on recruiters was mixed.

With the criterion of "policy reasonableness," we find that the Army's coefficients look the best when population is excluded, though a recruiter elasticity exceeding one implies increasing returns to recruiting. The Air Force is characterized by an excessively large recruiter effect, no pay effect, and a strong

EXHIBIT 3.12

SELECTED SIMPLE CORRELATIONS
(7601 - 8303)

	LAYM	LRELPAY	LALL2	TREND
LAYM	I			-.19
LRELPAY	-.61	I		
LALL2	-.75	.85	I	
LARMREC	-.27	.68	.67	
LNAVREC	.22	.46	.34	
LAFREC	.87	-.51	-.62	
LMCREC	.00	.50	.49	
LARMD13A	-.79	.68	.83	.36
LNAVD13A	-.64	.39	.58	-.06
LAFD13	-.24	.11	.26	-.10
LMCD13	-.57	.52	.61	.19

EXHIBIT 3.11d

ANALYSIS OF MARINE CORPS NPS MALE CONTRACTS
1-3 HSDG's
(Data series through 8303)

	M1 (7601-)	M2 (7601-)	M3 (7811-)
INTERCEPT	10.03	3.84**	-3.18
LAYM	-2.35	-----	-----
LMCREC	0.14	0.21	1.21**
LRELPAY	-0.04	0.01	0.71*
LALL2304	0.66**	0.71**	0.21
LMGPR	-0.05	-0.03	0.17
GI7611	0.13	0.05	-----
GI7612	0.72**	0.65**	-----
GIBILL	0.21	0.28**	-----
RHO	(1)-0.44**	(1)-0.42** (6) 0.25**	(24)0.37**
Root Mean Squared Error	0.126	0.120	0.096
R-Squared	0.79	0.85	0.95
DFE	65	66	36

[a] Estimates of seasonal factors not given.
* Significant at five percent level.
** Significant at one percent level.

EXHIBIT 3.11c

ANALYSIS OF AIR FORCE NPS MALE CONTRACTS
1-3 HSDG's
(Data series through 8303)

	F1 (7601-)	F2 (7601-)	F3 (7601-)	F4 (7811-)
INTERCEPT	.88	-14.57**	-12.35**	-16.56**
LAYM	-7.58**	-----	-----	-----
LAFREC	3.07**	2.70**	2.43**	3.03**
LRELPAY	-0.41	-0.21	-0.20	-0.15
LALL1304	0.78**	0.88**	0.75**	0.81**
LFGPR	0.64**	0.60**	0.65**	0.32
G40	0.15	0.15	0.13	0.29*
SCARCE3	-----	-----	-0.11*	-----
GI7611	0.24	0.21	0.22	-----
GI7612	0.89**	0.82**	0.86**	-----
GIBILL	0.31**	0.44**	0.36**	-----
RHO	(1)-0.45**	(1)-0.48**	(1)-0.49**	(1)-0.41**
Root Mean Squared Error	0.13	0.13	0.13	0.14
R-Squared	0.71	0.70	0.71	0.62
DFE	65	66	65	35

[a] Estimates of seasonal factors not given.
* Significant at five percent level.
** Significant at one percent level.

EXHIBIT 3.11b

ANALYSIS OF NAVY NPS MALE CONTRACTS
1-3A HSDG's
(Data series through 8303)

	N1 (7601-)	N2 (7601-)	N3 (7811-)
INTERCEPT	22.02**	4.84**	-3.54
LAYM	-9.63**	-----	-----
LNAVREC	0.89*	0.13	1.17**
LRELPAY	-1.06**	-0.38	-0.33
LALL2304	0.69**	0.86**	0.81**
GI7611	0.29**	0.24**	-----
GI7612	0.92**	0.82**	-----
GIBILL	0.26**	0.43**	-----
RHO	(1)-0.50** (2) 0.31** (3)-0.31** (4) 0.25** (14) 0.35**	(1)-0.53** (2) 0.28** (3)-0.32** (4) 0.27** (15) 0.31**	(1)-0.59** (2) 0.56** (3)-0.44** (4) 0.39**
Root Mean Squared Error	0.093	0.095	0.097
R-Squared	0.90	0.89	0.89
DFE	63	64	34

[a] Estimates of seasonal factors not shown.
* Significant at five percent level.
** Significant at one percent level.

EXHIBIT 3.11a

ANALYSIS OF ARMY NPS MALE CONTRACTS
1-3A HSDG's
(Data series through 8303)

	A1 (7601-)	A2 (7601-)	A3 (8001-)
INTERCEPT	19.99**	-4.80	8.56*
LAYM	-12.06**	-----	-----
LARMREC	1.78**	1.24**	-0.24
LRELPAY	0.20	0.52	1.03**
LALL2304	0.52**	0.85**	0.44**
GI7611	0.36**	0.32**	-----
GI7612	1.01**	0.86**	-----
GIBILLL	0.24**	0.50**	-----
ACF	0.14**	0.16*	0.25**
LAGPRSD	-----	-----	0.11
RHO	(1)-0.30** (2) 0.26**	(1)-0.34**	
Root Mean Squared Error	0.120	0.130	0.093
R-Squared	0.93	0.87	0.95
DFE	65	67	22

[a] Estimates of seasonal factors not given.
* Significant at five percent level.
** Significant at one percent level.
NOTE: Seasonal parameters not shown.

but omitted variables in the analysis. When, by inference, the error term is not independent across time, the ordinary least-squares (OLS) parameter estimates are not efficient and the standard error estimates are biased.

The SAS AUTOREG procedure that we have utilized estimates the parameters of the linear-in-logs model whose error term is assumed to be an autoregressive process of order "p." Lags of up to order 24 were tested, and parameters retained for the statistically significant lags.

4. HSDG Cohort Results: January 1976 - March 1983

Alternative models were examined for each Service; selected results are reported in Exhibits 3.11a-d. In general the models fit reasonably well as evidenced by the high R-square and low root MSE (square root of the mean square error); with the dependent variable measured in logarithms, the latter approximates the average percentage error. They range from 9 to 13 percent. Correction for autocorrelation among the residuals is important as evidenced by the significant RHO coefficients. Although not shown, the seasonal dummy variables also play a strong and significant role. The high degree of correlation among population, relative pay, recruiters, and unemployment makes it difficult to obtain reliable estimates of the separate effects. This is indicated by the simple correlations of the data series (see Exhibit 3.12), the intercorrelations among the larger number of variables in a given equation, and the correlations among the estimated coefficients.

For all the Services the strong effect of unemployment shines distinctly through the intercorrelations. The cross correlations found in the bivariate time-series analyses (described above) served as a guide in specifying the proper lag between enlistments and unemployment. For the Air Force, a lag of one period was indicated, and for the others a two-period lag was indicated. We did examine

Population

LAYM (7601 -)	=	The logarithm of the number of civilian male youth, 17-21 years old (interpolated from annual estimates) (Bureau of the Census and Market Statistics, Inc.)

Incentives, Standards, and Other Policy Changes

GIBILL	=	Binary variable indicating availability of GI Bill education benefits through December 1976
GI7611, GI7612	=	Two binary variables to account for the enlistment spikes in November and December 1976
ACF	=	Binary variable indicating availability of Army College Fund benefits, beginning October 1981
NFAT83	=	A binary variable indicating cessation by Navy of writing Cat. IV and non HSDG contracts during the July to December 1983 period
G40	=	A binary variable indicating increase in mental enlistment standards by the Air Force, beginning October 1982
SCARCE1	=	A binary variable indicating the limited number of Air Force jobs available during the October 1981 - December 1983 period
SCARCE3	=	A binary variable to reflect the limited number of Air Force jobs available vis-a-vis goals during the April 1977 - March 1979 period
FLOW	=	A binary variable indicating a move to less restrictive job-booking practices in the Air Force, beginning Dec. 1983.
MCEILING	=	A binary variable indicating a zero ceiling for Cat. IV's instituted by the Marine Corps, beginning April 1983

EXHIBIT 3.10

DEFINITION AND SOURCES OF VARIABLES EMPLOYED IN FORECAST FEASIBILITY TESTING

Recruiters

LARMREC (7601 -)	=	The logarithm of Army production recruiters assigned (with full, half or zero missions) (USAREC)
LNAVREC (7601 -)	=	The logarithm of Navy production plus fixed overhead recruiters (NRC)
LNRECP (7601 -)	=	The logarithm of Navy production recruiters (NRC)
LAFREC (7601 -)	=	The logarithm of Air Force NPS production recruiters (AFRS)
LMCREC	=	The logarithm of Marine Corps O/B recruiters (MCHQ) (with 8411/12 MOS)

Goals/Missions

LAGPRSD (8001 -)	=	The logarithm of Army net contract missions for 1-3A male HSDG plus HSSR enlistments per recruiter (USAREC)
LFGPR (7601 -)	=	The logarithm of Air Force net reservation goals per recruiter (the series is estimated for 1976 - 1977 with the use of EAD goals) (AFRS)
LMGPR (7601 -)	=	The logarithm of Marine Corps regular male goals per recruiter (MCHQ)

Labor Market Conditions

LALL (7201 -)	=	The logarithm of the unemployment rate for civilian labor force males, 16 years and over, seasonally adjusted (ALLUNEMP) (Bureau of Labor Statistics)
LYTH (7201 -)	=	The logarithm of the unemployment rate for civilian labor force males, 16-19 years old, seasonally adjusted (YTHUNEMP) (Bureau of Labor Statistics)
CIVERN (7601 -)	=	Median weekly earnings of male full-time workers, 16-19 years old; interpolated from quarterly data (Bureau of Labor Statistics)
LRELPAY (7601 -)	=	The logarithm of the ratio of first-year military pay (base pay plus BAS plus BAQ plus tax advantage) to annual civilian median earnings of 16-19 year old males

Navy binary variables are used to detect the effects of restrictions imposed on overproducing in the latter part of FY 1981 and the cessation of writing mental category four (Cat. IV) and non HSDG contracts in the second half of 1983. For the Air Force, the effects of limited numbers of available jobs during several subperiods are tested. The effect of increasing Air Force mental enlistment standards in October 1982 is examined also. For the Marine Corps the reduction of the allowable number of Cat. IV's that took place in April 1983 falls into the forecast test period (rather than the estimation period) and cannot be tested.

A linear-in-logs functional form was selected. It permits diminishing marginal returns with increases in supply factors, such as recruiting resources. It also permits the productivity of recruiters to be affected by the levels of other factors.

The coefficients of unemployment, recruiters, goals per recruiter, relative pay, and population, accurately measure partial elasticities only when multicollinearity is not pervasive; unfortunately the data series are highly intercorrelated. The coefficient of a binary variable measures the percentage change in enlistments caused by the presence of the program or policy change (with the same caveat regarding multicollinearity).

2. Data Definition and Sources

The variables that have been utilized for this phase of the project are defined in Exhibit 3.10. The larger EEWS data base is described in Exhibit 7.1.

3. Estimation Technique

In time-series regression analysis it is typical to find autocorrelated residuals -- that is, strings of high to low values. This is usually interpreted to reflect the presence of important,

recruiter prospecting, advertising campaigns, and some Service-quality screening. From this flow, mental and physical testing and moral screening will identify those eligible for contracting. The conversion rate (applicants to contracts) of this group will depend upon the conditions of the job offer (job type, waiting period, location, training, bonuses, other incentives), the persuasiveness of the recruiter and MEPS counselors, and perhaps, changing labor market conditions.

In the present empirical work we intercept the enlistment pipeline at the contracting stage, and focus on analyzing the factors affecting gross contracts and subsequently on forecasting gross contracts. Applicants are not modeled separately, though we do test (see Chapter V) whether prior-in-time application rates augment the capability to forecast contracts.

Reduced-form equations that combine the major (and measureable) supply and demand factors at the application and contracting stages have been estimated. For each Service we have production recruiters series, and for the Air Force and Marine Corps we have approximated contract goals for the full period. Contract missions are available for the Army for a shorter period only, while the Navy did not put contract objectives into place until FY 1982. Accession goals have not been utilized because they do not reflect changes in DEP management policies. Goals are expressed in the estimating equations relative to the number of recruiters.

Civilian alternatives are measured by unemployment rates and military pay relative to youth earnings. A male youth population variable reflects the slowly changing labor pool.

With regard to incentives, standards, and other policy changes, several binary variables account for the presence of GI Bill benefits through December 1976. For the Army, the effect of the availability of Army College Fund benefits is also tested. For the

C. Explanatory (Regression) Models

Monthly time-series regression models were estimated over the January 1976 - March 1983 period for male HSDG cohorts. Due to the unavailability of a separate breakout on high school seniors before FY 1979 (they were included with non HSDG's), separate and combined models for HSSR and HSDG cohorts were estimated over the November 1978 - March 1983 period. The dependent variables are NPS male gross contracts, either 1-3 or 1-3A, depending upon the Service.

1. Model Specification

The number and quality of Armed Forces enlistments is the outcome of a process that equilibrates the supply of youth labor and the demand for first-term accessions. The demand for NPS enlistments is derived as a function of overall manpower requirements and expected re-enlistment rate. It is shaped by prevailing education, mental, physical, and moral enlistment standards. Demand is expressed by accession and contract goals (missions) by quality cohort.

The Services utilize a variety of policy and program levers to equilibrate the supply of applicants and the demand for qualified NPS accessions. The process can be viewed as an enlistment pipeline. At the inquiry stage, there is a flow of walk-ins, of prospects responding to recruiter invitation, and of leads responding to advertising. In addition, the flow is affected by civilian job and earnings prospects and, presumably, by the size of the youth pool. Those candidates of obviously low mental appitude, of poor attitude, and of questionable moral qualification are discouraged from formal application. The remainder are encouraged to apply -- "take a test and see if they qualify."

Thus, the observable flow of applicants depends upon exogenous supply factors (including attitudes/taste toward military service),

EXHIBIT 3.13a

ANALYSIS OF ARMY NPS MALE CONTRACTS
1-3A HSSR'S AND HSSR'S PLUS HSDG'S
(Data series through 8303)

	HSSR'S	HSSR'S PLUS HSDG'S			
	A4 (7811-)	A5 (7811-)	A6 (8001-)	A7 (7910-)	A8 (7910-)
INTERCEPT	4.38*	-0.17	8.12*	5.47*	-2.13
LAYM	-----	-----	-----	-----	-----
LARMREC	0.06	0.76**	-0.17	0.11	0.58
LRELPAY	2.11**	1.32**	1.22**	1.15**	0.35
LALL2304	0.79**	0.69**	0.56**	0.66**	0.32
ACF	0.21**	0.22**	0.23**	0.26*	0.27**
LAGPRSD	-----	-----	0.10	-----	-----
LA6DS13A	-----	-----	-----	-----	0.53**
RHO	(3) 0.46**	(2) 0.38** (10) 0.32**			
RMSE	0.099	0.093	0.079	0.077	0.069
R-Squared	0.99	0.98	0.97	0.97	0.98
DFE	36	35	22	26	19

[a] Estimates of seasonal factors not shown.
* Significant at five percent level.
** Significant at one percent level.

EXHIBIT 3.13b

ANALYSIS OF NAVY NPS MALE CONTRACTS
1-3A HSSR's AND HSSR's PLUS HSDG's
(Data series through 8303)

	HSSR's N4 (7811-)	HSSR's PLUS HSDG's N5 (7811-)	N6 (7811-)
INTERCEPT	-22.59**	-8.21*	19.98**
LAYM	-----	-----	-----
LNAVREC	3.34**	1.78**	-1.77**
LRELPAY	-0.50	-0.32	-0.43*
LALL2304	1.25**	0.88**	0.72**
LNAP6DS	-----	-----	0.15
RHO	(15) 0.36**	(1) -0.36**	
Root Mean Squared Error	0.122	0.102	0.059
R-Squared	0.94	0.82	0.93
DFE	37	37	20

[a] Estimates of seasonal factors not shown.
* Significant at five percent level.
** Significant at one percent level.

EXHIBIT 3.13c

ANALYSIS OF AIR FORCE NPS MALE CONTRACTS
1-3 HSSR's AND HSSR's PLUS HSDG's
(Data series through 8303)

	HSSR's	HSSR's PLUS HSDG's	
	F5	F6	F7
	(7811-)	(7811-)	(7910-)
INTERCEPT	-25.49**	-18.58**	-9.76
LAYM	-----	-----	-----
LAFREC	3.99**	3.32**	2.68**
LRELPAY	0.88	0.01	-0.34
LALL1304	1.35**	0.93**	0.25
LFGPR	0.03	0.27	-0.26
G40	-0.06	0.24	0.36**
LAPDS136	-----	-----	-0.23
RHO	(1)-0.39**	(1)-0.40**	
Root Mean Squared Error	0.152	0.134	0.103
R-Squared	0.85	0.62	0.81
DFE	35	35	18

[a] Estimates of seasonal factors not shown.
* Significant at five percent level.
** Significant at one percent level.

EXHIBIT 3.13d

ANALYSIS OF MARINE CORPS NPS MALE CONTRACTS
1-3 HSSR's AND HSSR's PLUS HSDG's
(Data series through 8303)

	HSSR's	HSSR's PLUS HSDG's	
	M4 (7811-)	M5 (7811-)	M6 (7910-)
INTERCEPT	-2.17	-2.84	19.28*
LAYM	-----	-----	-----
LMCREC	.95**	1.21**	-1.91
LRELPAY	1.99**	1.24**	0.48
LALL2304	0.51**	0.27*	0.87**
LMGPR	0.16	0.21*	0.03
LMAPDS6	-----	-----	0.16
Root Mean Squared Error	0.117	0.096	0.080
R-Squared	0.96	0.94	0.94
DFE	36	37	19

[a] Estimates of seasonal factors not shown.
* Significant at five percent level.
** Significant at one percent level.

to adequately track should not be surprising. There are just too many non-systematic influences at work. Accordingly, we believe that the regression model, as a behavioral approach, has a comparative advantage in monitoring enlistments and, moreover, it can be improved with better explanatory variables.

The regression model analyses indicate that monitoring enlistments is a feasible proposition. The capability of the models to track are not outstanding at this time, but they are good and can be made better. The major missing ingredient is more information about Service programs and policies. With a minimum of program and policy information, we are already achieving average tracking errors of 10-15 percent. With more information the standard errors of the estimates can be reduced and the confidence intervals narrowed.

Combing through the residuals we find certain patterns that suggest missing information. Consider the HSDG cohorts. For each Service there is large (that is, over 20 percent) overprediction in March 1979 and large underprediction in May 1979. Does this suggest DOD-wide policy changes, or perhaps errors in the enlistment data? There also seems to be a pattern of large overprediction during the third and fourth quarters of FY 1976 in all the Services except the Army. Perhaps this reflects a quieting before the GI Bill finale. And what about the constant overprediction for the Marine Corps towards the end of FY 1977? Turning to the HSSR cohorts, what about the large underprediction in the Air Force for the first half of FY 1980?

Overall, the numbers of large residuals are relatively few in the Army and Navy, noticeably higher in the Air Force, and moderate in the Marine Corps.

SIZE OF RESIDUALS

	HSDG COHORTS (85 obs.)		HSSR COHORTS (53 obs.)	
	Over 20%	15-20%	Over 20%	15-20%
ARMY	5	6	6	5
NAVY	6	6	2	6
AIR FORCE	13	5	11	6
MARINE CORPS	12	6	3	3

In the interest of arousing curiosity, consider the timing of the largest residuals (HSDG cohorts; HSSR cohorts):

ARMY	11/77, 5/78, 3/79, 5/79, 11/80;
	1/79, 4/79, 7-8/79, 3-4/80,
NAVY	5-9/76, 3/79;
	11/78, 1/83
AIR FORCE	1/76, 5-7/76, 9/76-1/77, 3/79, 5/79, 2/80, 11/80;
	11/78, 2/79, 5/79, 10/79-4/80, 8/80, 8/81
MARINES	1/76, 5/76, 7-9/76, 6-10/77, 3/79, 5/79, 2/80;
	6/80, 10/80, 6/82

With these dates as a catalyst, it should be possible to begin piecing together program and policy stories.

In assessing these models for monitoring capability, several other features need emphasis. We have noted considerable sensitivity of the estimated coefficients to the particular observation period. The combination of high intercorrelations and (not coincidentally) program changes that have occurred with explanatory factor movements have produced unstable and unrealistic coefficients as a whole (with the possible exception of the Army HSDG model). The implication for improved monitoring capability is monthly re-estimation to ensure that the models continue to track well as circumstances change.

CHAPTER IV

PREDICTING UNEMPLOYMENT

Movements in labor market conditions so prominently affect the flow of enlistments that, in order to adequately forecast enlistments, it is necessary to possess the capability to make short-term forecasts of unemployment. In this chapter we first describe the unemployment rate modeling we have carried out using univariate time series and leading indicator models; next we present short-term forecasts made by several public and private organizations; and finally we evaluate the various approaches.

A. Univariate Time-Series Models

Two civilian labor force unemployment series were modeled:

- male, 16 years and over, seasonally adjusted series (ALLUNEMP):
- male, 16-19 years, seasonally adjusted series (YTHUNEMP).

Monthly models were estimated over the period beginning January 1972. Forecast tests were conducted over the April 1983 - January 1984 period. Estimated parameters and model statistics are reported in Exhibit 4.1. To achieve stationarity, it was necessary to take first differences of ALLUNEMP and YTHUNEMP. After much experimentation, we found that similar models gave the best fits for the seasonally adjusted series: ARMA (1,1) models with (slightly different) seasonal moving average factors. As indicated by the check of residuals, the ALLUNEMP series is a better fit than the YTHUNEMP series. This probably reflects the greater variability of the latter series.

In Exhibits 4.2 and 4.3, we present predictions produced by these univariate time-series models for the April 1983 to January 1984 period. Following the actual series (col. 1), we list the one-step-ahead within sample predictions (col.2). Multi-step-ahead forecasts are produced when the model runs forward solely on its own predictions (col. 3), rather

EXHIBIT 4.1

UNIVARIATE UNEMPLOYMENT RATE MODELS

	PARAMETER	LAG	ESTIMATE	STD. ERROR	T-RATIO	AUTOCORRELATION CHECK OF RESIDUALS TO LAG 6	12	18	24
ALLUNEMP						.45	.70	.76	.95
D=(1)	AR1,1	1	.87	.07	11.37				
P=(1)	MA1,1	1	.59	.12	4.82				
Q=(1)(12)	MA2,1	12	.35	.09	4.07				
(24)	MA3,1	24	.33	.09	3.62				
YTHUNEMP						.37	.48	.78	.76
D=(1)	MA1,1	1	.18	.08	2.15				
Q=(1)	MA2,1	2	.20	.08	2.43				
(12,24)	MA2,2	12	.29	.09	3.30				

EXHIBIT 4.2

UNIVARIATE MODEL FORECASTING TESTS FOR ALLUNEMP[a]

	ACTUAL OBS. (1)	WITHIN SAMPLE PREDICTION (2)	W/IN SMPL. MULTISTEP FORECAST (3)	OUT/SMPL. MULTISTEP FORECAST (4)	OUT-OF-SAMPLE ERROR	OUT-OF-SAMPLE PERCENT ERROR
8304	10.7	10.6	10.6	10.6	0.1	0.9
8305	10.5	10.6	10.4	10.4	0.1	0.5
8306	10.1	10.3	10.2	10.3	-0.2	-1.7
8307	9.9	10.0	10.2	10.3	-0.4	-3.6
8308	9.8	9.7	10.1	10.1	-0.3	-3.6
8309	9.6	9.6	10.0	9.7	-0.1	-4.3
8310	9.1	9.2	9.7	9.5	-0.4	-6.7
8311	8.6	8.8	9.4	9.3	-0.7	-10.5
8312	8.3	8.3	9.3	9.3	-1.0	-11.5
8401	8.1	8.2	9.2	9.2	-1.1	-13.5

8304-8309	RMSE = 0.3	RMSPE = 3.9
8304-8312	RMSE = 0.6	RMSPE = 7.6

a Predictions/forecasts are rounded to nearest tenth.

EXHIBIT 4.3

UNIVARIATE MODEL FORECASTING TESTS FOR YTHUNEMP[a]

	ACTUAL OBS. (1)	WITHIN SAMPLE PREDICTION (2)	W/IN SMPL. MULTISTEP FORECAST (3)	OUT/SMPL. MULTISTEP FORECAST (4)	OUT-OF-SAMPLE ERROR	OUT-OF-SAMPLE PERCENT ERROR
8304	24.4	24.8	24.8	24.8	-0.4	-1.6
8305	23.9	24.2	24.6	24.6	-0.7	-2.9
8306	24.0	23.6	24.2	24.3	-0.3	-1.2
8307	23.8	24.1	24.4	24.5	-0.7	-2.9
8308	24.3	23.8	24.4	24.4	-0.1	-0.4
8309	22.8	24.0	24.1	24.2	-1.4	-6.1
8310	22.5	22.9	24.0	24.1	-1.6	-7.1
8311	20.2	22.0	23.4	23.6	-3.4	-16.8
8312	20.4	20.5	23.4	23.6	-3.2	-15.7
8401	20.8	20.3	23.3	23.4	-2.6	-12.5

8304-8309	RMSE = 1.0	RMSPE = 4.2
8304-8312	RMSE = 1.9	RMSPE = 9.4

a Predictions/forecasts are rounded to nearest tenth.

than starting over again each month with actual values. The out-of-sample, multi-step forecasts (col. 4) utilize parameters estimated over the January 1972 to March 1983 period; this is a demanding test because no future knowledge is admitted.

The results indicate very good tracking capabilities (col. 1) for both series and good prediction capabilities (col. 4) for the ALLUNEMP series. The predictors fall in step with the actual series through six months out, and then the actuals fall markedly faster. For six and nine period forecasts, the RMSPE's are only 3.9 and 7.6, respectively. For the YTHUNEMP series, the predictions fall noticeably more slowly over the entire forecasting period.

B. Leading Indicator Models

Preliminary analysis was conducted for the purpose of modeling and forecasting unemployment with leading economic indicators.

From a variety of economic processes, a set of candidates were identified that have tended to lead aggregate economic activity. These candidates are listed in Exhibit 4.4 along with their median lead times (in months) at peaks and troughs. As can be seen, unemployment itself has been a leader at peaks though it has lagged at troughs.[12] These candidates were screened by comparing their timing with that of unemployment. Those that have followed unemployment (both measured vis-a-vis aggregate economic activity) were eliminated; data for several series (nos. 5 and 19) did not become available in time for inclusion; and selections were made between similar series (e.g. nos. 7, 8 and 20, 27).

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12 There also has been variability in the relationship between turning points in unemployment and overall economic activity; see the discussion in Volume II, pp. 97-101.

EXHIBIT 4.4

LEADING ECONOMIC INDICATOR CANDIDATES FOR UNEMPLOYMENT MODELING

PROCESS AND SERIES	MEDIAN TIMING AT PEAKS	TROUGHS	TURNS
EMPLOYMENT AND UNEMPLOYMENT			
1. Average workweek, production workers, manufacturing	-12	-2	-5
21. Average weekly overtime, production workers, manufacturing	-13	0	-5
5. Average weekly initial claims, state unemployment insurance	-12	0	-8
46. Index of help-wanted advertising	$-5\frac{1}{2}$	+2	-1
43. Unemployment rate, total	-7	+3	$-\frac{1}{2}$
PRODUCTION AND INCOME			
75. Industrial production, consumer goods	-2	-1	-1
CONSUMPTION, TRADE, ORDERS, AND DELIVERIES			
7. New orders, durable goods	-8	-1	$-4\frac{1}{2}$
8. New orders, consumed goods	-5	-3	$-4\frac{1}{2}$
FIXED CAPITAL INVESTMENT			
20. Contracts and orders, plant and equipment	-8	-2	$-5\frac{1}{2}$
27. New orders, capital goods, nondefense	-8	-2	-6
28. New private housing units begun, total	-13	-8	$-9\frac{1}{2}$
PRICES, COSTS			
19. Index of stock prices, 500 common stocks	-9	-4	$-5\frac{1}{2}$
COMPOSITE INDICATORS			
910. Twelve leading indicators	-11	-4	-7

By taking the differences in timing between unemployment and the candidates, we specified a set of leading economic indicator variables (LEI) with appropriate leads. To capture economic expansion (i.e. moving towards a peak) we examined these variables: LEI28 (-6), LEI21 (-6), LEI1 (-5), LEI910 (-4); and to capture contraction (i.e., moving towards a trough) we examined these variables: LEI28 (-11), LEI8 (-7), LEI910 (-7), LEI20 (-5), LEI1 (-5), LEI75 (-4).

After experimentation with different combinations of these variables, we settled on a model producing a six month lead because reducing the lead time to four months did not buy an improved fit. An autoregressive estimation technique was used to estimate the models. In Exhibit 4.5 we report T-values of the estimated coefficients and summary statistics.

For the two unemployment series, the leading indicator variables are all statistically significant, and with the exception of LEI 910 have the expected sign. The exception, LEI 910, has an almost zero correlation with the other explanatory variables. Hence multicollinearity is not indicated, and its positive sign probably indicates that it is one cycle ahead of unemployment -- not merely leading it in the current cycle.

Unemployment predictions from the leading indicator models are shown in Exhibit 4.6. For ALLUNEMP they fall noticeably faster than the actual series throughout the period. For YTHUNEMP, the forecasts fall slightly faster than the actuals, and overall the errors are quite respectable: the RMSPE is 6.0 percent for the ten month period.

C. Outside Unemployment Forecasts

Among other forecasters of unemployment three would be readily available to the EEWS: forecasts of quarterly rates by the Bureau of Economic Analysis (Department of Commerce) and by the Congressional Budget Office and monthly forecasts by the Georgia State University

EXHIBIT 4.5

LEADING INDICATOR MODELING OF UNEMPLOYMENT[a]

EXPLANATORY/"LAG" VARIABLES[b]		T-VALUES	
		ALLUNEMP	YTHUNEMP
LEI28(11)	Total private housing units begun	-4.11	-2.70
LEI8(7)	New orders, consumer goods	-3.39	-2.70
LEI910(7)	Composite of 12 leading indicators	3.77	3.31
LEI28(6)	Total private housing units begun	-6.25	-5.42
LEI21(6)	Average weekly overtime, production workers, manufacturing	-3.53	-1.61
RHO		(1) -15.30	(1) -8.67
		(6) 2.89	
Root MSE		.36	.91
R-Square		.71	.65
DFE		105	106

a Linear-in-logs equations were estimated over the January 1972-March 1983 period with monthly observations. An autoregressive regression procedure was utilized.

b Seasonal dummies were included, but are not shown in the table. As expected, with the seasonally adjusted dependent variables they were not statistically significant.

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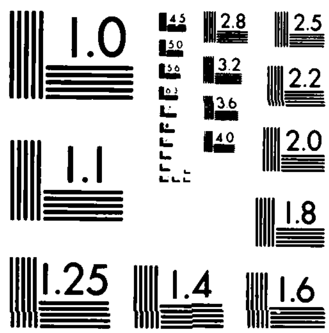

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

EXHIBIT 4.6

LEADING INDICATOR MODEL
FORECASTING TESTS FOR ALLUNEMP AND YTHUNEMP

ALLUNEMP
(Out-of-Sample)

	ACTUAL	FORECAST	ERROR	% ERROR
8304	10.7	10.1	-0.6	-5.6
8305	10.5	9.8	0.7	6.7
8306	10.1	9.2	0.9	8.9
8307	9.9	8.4	1.5	15.2
8308	9.8	7.8	2.0	20.4
8309	9.6	7.8	1.8	18.7
8310	9.1	7.4	1.7	18.7
8311	8.6	7.6	1.0	11.6
8312	8.3	7.0	1.3	15.7
8401	8.1	7.2	0.9	11.1
8304-8309				RMSPE=15.8
8304-8312				RMSPE=14.9

YTHUNEMP
(Out-of-Sample)

	ACTUAL	FORECAST	ERROR	% ERROR
8304	24.4	24.3	0.1	0.4
8305	23.9	23.9	0.0	0.0
8306	24.0	23.4	0.6	2.5
8307	23.8	22.2	1.6	6.7
8308	24.3	21.1	3.2	13.2
8309	22.8	21.7	1.1	4.8
8310	22.5	21.3	1.2	5.3
8311	20.2	21.2	-1.0	-5.0
8312	20.4	20.0	0.4	2.0
8401	20.8	20.0	0.8	3.8
8304-8309				RMSPE=6.8
8304-8312				RMSPE=6.0

Economic Forecasting Project.[13] Their forecasts for total (male and female) civilian unemployment, made just prior to the forecast test period are reported in Exhibit 4.7. As can be seen, their errors are no better than the leading indicator model and are substantially larger than the univariate model errors for both the ALLUNEMP and YTHUNEMP series.

D. Evaluation

The RMSPE values are summarized in Exhibit 4.8. The univariate time-series model with the ALLUNEMP series and the leading indicator model for the YTHUNEMP series are preferred over the others. The former is utilized in the enlistment forecasting tests described in the next chapter. The univariate time-series methods can deal with a wide variety of patterns involving trend, seasonal, and/or cyclical subpatterns. Like virtually all quantitative forecasting techniques, these methods have much more difficulty forecasting the cyclical subpatterns and predicting turning points, than they do in dealing with seasonal, trend, and horizon of subpatterns. *On the one hand, the fortuitous choice of a forecasting* test period which excludes turning points may have been too easy a test. On the other hand, in this situation, the univariate model did out perform the others. Further testing will be conducted in Phase II.

The leading indicator models are in an early stage of development and the current results suggest that further research would be profitable -- especially in view of the potential for dealing with turning points.

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13 Two others that may be of use and are available free of charge are put out by Manufacturer's Hanover Trust and by the American Statistical Association with the National Bureau for Economic Research. These and other sources are reviewed by Stephen K. McNees and John Ries, "The Track Record of Macroeconomic Forecasts," New England Economic Review, November/December 1983.

EXHIBIT 4.7

OUTSIDE UNEMPLOYMENT FORECAST TESTS FOR TOTAL CIVILIAN UNEMPLOYMENT
APRIL-DECEMBER 1983

	ACTUAL RATES		FORECASTS BEA	CBO	GSU	PERCENT ERRORS BEA	CBO	GSU
8304	10.2				10.8			-5.9
8305	10.1	10.1	10.6	10.6	10.8	-4.9	-4.9	-6.9
8306	10.0				10.7			-7.0
8307	9.5				10.7			-12.6
8308	9.5	9.4	10.4	10.6	10.6	-10.6	-12.8	-11.6
8309	9.2				10.5			-14.1
8310	8.8				10.5			-19.3
8311	8.4	8.5	9.9	10.4	10.5	-16.5	-22.4	-25.0
8312	8.2				10.4			-26.8
8304-8312		RMSPE				11.7	15.2	17.5

BEA Bureau of Economic Analysis (Department of Commerce), reported 1/24/83
CBO Congressional Budget Office
GSU College of Business Administration, Economic Forecasting Project, Georgia State University, monthly projections issued 4/18/83

EXHIBIT 4.8

UNEMPLOYMENT FORECASTING ACCURACY SUMMARY
April-December 1983

MODEL/FORECASTER	ROOT MEAN SQUARE PERCENTAGE ERROR ALLUNEMP	YTHUNEMP	TOTAL UNEMPLOYMENT
Univariate Time Series	7.6	9.4	-----
Leading Indicator	14.9	6.0	-----
BEA	-----	-----	11.7
CBO	-----	-----	15.2
GSU	-----	-----	17.5

CHAPTER V

FORECASTING TESTS

A. Test Procedures

Time-series and regressions models (as described above) were estimated through March 1983 and utilized as forecasting equations for the April to December 1983 period. The objective was to validate the model by testing it against observations that lie outside the estimation period. To accomplish this we assumed perfect knowledge of future numbers of recruiters, goals/missions, and relative pay, but did utilize the unemployment univariate time-series forecasts described in the previous chapter. It should be pointed out that the few policy variables in the models are assumed unchanged, and that future policy changes (i.e. during the forecast period) are either unknown (e.g., did the Services pursue high school seniors more aggressively as the market softened) or cannot be modeled directly because they first occur during the forecast period (e.g., the lowering of the mental category four ceiling in the Marine Corps.) In all, these considerations make for a stringent test.

The obvious measure of forecast quality if one is using a least-squares criterion in model estimation, is the average squared forecast error:

(1) $$MSE = \Sigma(F_t - A_t)^2/n$$

or the root mean square error:

(2) $$RMSE = \sqrt{\frac{\Sigma(F_t - A_t)^2}{n}}$$

or the root mean square percentage error:

$$(3) \qquad RMSPE = 100\sqrt{\frac{\Sigma(F_t - A_t)^2}{nA_t^2}}$$

MSE, RMSE and RMSPE are consistent with a notional quadratic loss or cost-of-error function: proportionately greater weight is given to large forecast errors than to small ones. Moreover MSE is to be preferred to mean absolute error (MAE) in the same way that the variance is to be preferred as a measure of dispersion to measures based on absolute deviations. One attraction of MSE-based measures of accuracy is that they are linked directly to the variance and mean of the prediction error since, denoting F - A by e,

$$(4) \qquad \frac{\Sigma(F_t - A_t)^2}{n} = \frac{\Sigma e_t^2}{n} = \frac{\Sigma(e_t - \bar{e} + \bar{e})^2}{n}$$

$$= \frac{\Sigma(e_t - \bar{e})^2}{n} + \bar{e}^2$$

The first term is the variance of e and the second is the square of $\bar{e}$, the mean error. Therefore RMSE is an increasing function of the variance and the mean error, and the larger these are, the more inaccurate are the forecasts.

B. Comparison of Time-Series and Regression Models

Comparisons between these two types of models are focused on the 1-3A HSDG and HSSR cohorts. Summary forecast test statistics are reported in Exhibit 5.1. Results are shown for the full period regression models in which population is excluded, for the univariate models, and for the two bivariate models with ALLUNEMP and YTHUNEMP.[14]

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14 A bivariate youth model could not be estimated for the Air Force due to insufficient cross correlation. Bivariate models for the HSSR cohort were not estimated because they are quite time consumming and because the payoff, based on the HSDG results, did not appear promising.

EXHIBIT 5.1

TIME SERIES VS REGRESSION MODEL FORECASTING TESTS (8304-8312)

COHORT/MODEL	ARMY	NAVY	AIR FORCE	MARINE CORPS
	ROOT MEAN SQUARE PERCENTAGE ERROR			
HSDG 1-3A				
R	7.4	14.3	13.0	19.6
U	23.5	7.9	17.3	28.7
B:ALLUNEMP	23.0	16.0	17.7	19.7
B:YTHUNEMP	24.6	16.6	----	29.7
HSSR 1-3A				
R	23.4	30.1	38.3	15.6
U	10.8	17.9	42.3	12.6
	ROOT MEAN SQUARE ERROR			
HSDG 1-3A				
R	265	414	366	214
U	743	207	485	312
B:ALLUNEMP	716	424	516	212
B:YTHUNEMP	778	443	----	325
HSSR 1-3A				
R	424	453	348	155
U	208	237	347	111

DEFINITIONS: R = Regression model (7601-8303);
U = Univariate time series model;
B:ALLUNEMP = Bivariate time series model with ALLUNEMP;
B:YTHUNEMP = Time series model with YTHUNEMP; see Exhibits

Note first that the bivariate models are no more accurate than the univariate models, except possibly for the Marine Corps. This is consistent with the low cross correlations discussed earlier.

In general forecast accuracy seems better with the regression model for the HSDG cohorts, and better (though comparatively larger) with the univariate models for the HSSR cohorts -- but there are exceptions. For the Navy HSDG cohort, the univariate forecasts are better; and for the Marine Corps HSDG cohort, the regression and bivariate forecast errors are about the same.

In addition to forecast accuracy, the error pattern — constant under/over prediction -- should be examined in evaluating the models. Strong patterns may suggest model deficiencies (e.g. omitted factors), and/or policy changes that have not been accounted for. The observed patterns are summarized in Exhibit 5.2. The underlying data are contained in Exhibits 5.3a-d and 5.4a-d. With regard to the HSDG cohorts, the tendency with the U models is overprediction (severe for the Army); with the R model, there are mixed patterns as well as overprediction. For the HSSR cohorts, the U models tend to either under or overpredict, and the R models tend uniformly to underpredict. Thus, with absence of pattern as a criterion, there is some preference for the R models applied to the HSDG cohorts, and a weaker preference for the U models applied to the HSSR cohorts.

Another criterion in evaluating the U and R models concerns the statistical confidence with which forecasts can be made. High levels of confidence (i.e. low standard errors of the estimate) imply a narrow confidence band or interval around the forecast. A comparison of the U and R models using the Navy HSDG cohort as an example (Exhibit 5.3b reveals that the univariate confidence intervals widen over time. This is characteristic of modeling and forecasting nonstationary series (those displaying a trend). Essentially the unknown nature of the future trend is accounted for with a standard error that grows over time. This could be a compelling reason for preferring a regression model for forecasting.

EXHIBIT 5.2

COMPARISON OF UNIVARIATE TIME SERIES AND REGRESSION MODEL ERROR PATTERNS: 1-3A COHORTS

SERVICE	UNIVARIATE		REGRESSION	
	HSDG	HSSR	HSDG	HSSR
ARMY	Increasing OP	Mixed with increasing OP	Mixed	Increasing UP
NAVY	Constant OP	Rising then falling UP	Increasing OP then mixed	Increasing UP
AIR FORCE	Mixed	Constant UP	Mixed then UP	Constant UP
MARINE CORPS	OP	UP then OP	OP then mixed	Rising then falling UP

OP = Overprediction
UP = Underprediction

EXHIBIT 5.3a

ARMY 1-3A FORECASTING TESTS
HSDG MODEL (7601-8303)

REGRESSION MODEL: EQUATION A2

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	3117	4204	2719	3411	-294	-9.4
8305	3281	4400	2845	3569	-288	-8.8
8306	4381	5636	3644	4572	-191	-4.3
8307	4382	5559	3595	4510	-128	-2.9
8308	4768	5412	3499	4390	377	7.9
8309	4145	4725	3055	3833	311	7.5
8310	3056	4125	2667	3346	-290	-9.5
8311	3362	3953	2556	3207	154	4.6
8312	2791	3745	2422	3038	-247	-8.8
					RMSE=265	RMSPE=7.4

UNIVARIATE MODEL

	STD ERROR	U95	L95	FCAST	ERROR	% ERROR
8304	274	3999	2923	3461	-344	-11.0
8305	343	4519	3173	3846	-565	-17.2
8306	359	5409	4002	4706	-325	-7.4
8307	392	5654	4114	4884	-502	-11.4
8308	436	5960	4250	5105	-337	-7.0
8309	464	5801	3981	4891	-746	-17.9
8310	488	5062	3146	4104	-1084	-35.4
8311	516	5214	3188	4201	-839	-24.9
8312	543	5162	3034	4098	-1307	-46.8
					RMSE=743	RMSPE=23.5

EXHIBIT 5.3b

NAVY 1-3A FORECASTING TESTS
HSDG MODELS (7601-8303)

REGRESSION MODEL: EQUATION N2

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	2228	2906	2082	2472	-244	-10.9
8305	2321	3081	2206	2621	-300	-12.9
8306	2820	4151	2973	3531	-711	-25.2
8307	3109	4415	3162	3756	-647	-20.8
8308	3374	4686	3356	3986	-612	-18.1
8309	3295	3853	2760	3278	16	.5
8310	2392	3148	2255	2678	-286	-11.9
8311	2571	2925	2095	2488	82	3.2
8312	2338	2658	1903	2261	76	3.3

RMSE=414 RMSPE=14.3

UNIVARIATE MODEL

	STD ERROR	U95	L95	FCAST	ERROR	% ERROR
8304	262	2930	1900	2415	-187	-8.3
8305	371	2817	1360	2088	233	10.0
8306	396	3823	2268	3046	-226	-8.0
8307	420	4200	2553	3377	-268	-8.6
8308	442	4481	2746	3613	-239	-7.0
8309	463	4260	2443	3352	-57	-1.7
8310	483	3621	1724	2673	-281	-11.7
8311	503	3714	1741	2727	-156	-6.0
8312	521	3476	1430	2453	-115	-4.9

RMSE=207 RMSPE=7.9

EXHIBIT 5.3c

AIR FORCE 1-3A FORECASTING TESTS
HSDG MODELS (7601-8303)

REGRESSION MODEL: EQUATION (not previously reported) (with SCARCE3)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	2176	2767	1799	2250	-74	-3.4
8305	2325	2707	1760	2202	122	5.2
8306	2387	3289	2138	2675	-288	-12.0
8307	2746	3385	2201	2753	-7	-0.2
8308	3082	3696	2403	3006	75	2.4
8309	2976	3180	2067	2586	389	13.0
8310	2401	2541	1652	2066	334	13.9
8311	2353	2449	1592	1992	360	15.2
8312	3092	2771	1802	2254	837	27.0

RMSE=366 RMSPE=13.0

UNIVARIATE MODEL

	ACTUAL	U95	L95	FCAST	ERROR	% ERROR
8304	2176	3341	1984	2662	-486	-22.3
8305	2325	3392	1615	2504	-179	-7.6
8306	2387	3051	1253	2152	234	9.8
8307	2746	3304	1505	2405	340	12.3
8308	3082	3175	1375	2275	806	26.1
8309	2976	3280	1481	2381	594	19.9
8310	2401	3564	1680	2622	-221	-9.2
8311	2353	3593	1651	2622	-269	-11.4
8312	3092	3316	1371	2344	748	24.1

RMSE=485 RMSPE=17.3

EXHIBIT 5.8a

REGRESSION MODEL FORECASTING TESTS (8304-8312)
MARINE CORPS 1-3 COHORTS

COHORT/EQUATION	ESTIMATION PERIOD/MODEL	FORECAST ERROR RMSPE	FORECAST ERROR RMSE
HSDG			
M2	7601-8303	14.0	235
M3	7811-8303	18.1	298
HSSR			
M4	7811-8303	18.8	328
HSDG PLUS HSSR			
M5	7811-8303 without Applicants	9.9	338
		8.5[a]	306[a]
M6	7910-8303 with Applicants	11.1[a]	407[a]

[a] Forecast test refers to 8304-8309 period.

EXHIBIT 5.7c

AIR FORCE 1-3 FORECASTING TESTS
HSDG PLUS HSSR MODEL (7811-8303)

REGRESSION MODEL: EQUATION F6 (WITHOUT APPLICANTS)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	3805	4911	3158	3974	-169	-4.4
8305	3977	4781	3075	3869	107	2.7
8306	4004	5126	3297	4148	-144	-3.6
8307	4039	5616	3612	4544	-505	-12.5
8308	4492	5801	3731	4694	-202	-4.5
8309	4271	5133	3301	4154	116	2.7
8310	3813	4045	2601	3273	539	14.1
8311	3868	3713	2388	3005	862	22.3
8312	5655	4203	2703	3401	2253	39.8
					RMSE=	RMSPE=
					849	16.7

EXHIBIT 5.7b

AIR FORCE 1-3 FORECASTING TESTS
HSDG MODELS (7601-8303) HSSR MODELS (7811-8303)

REGRESSION MODEL: EQUATION F2 (HSDG)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	2659	3389	2203	2756	-97	-3.6
8305	2801	3331	2165	2709	91	3.2
8306	2954	4113	2674	3345	-391	-13.2
8307	3413	4391	2855	3571	-158	-4.6
8308	3839	4777	3106	3885	-46	-1.2
8309	3741	4126	2683	3356	384	10.3
8310	2974	3168	2060	2576	397	13.3
8311	2926	2996	1948	2437	488	16.7
8312	3883	3360	2184	2732	1150	29.6
					RMSE=479	RMSPE=13.6

REGRESSION MODEL: EQUATION F5 (HSSR)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1146	1311	794	1032	113	9.9
8305	1176	1037	628	817	358	30.4
8306	1050	754	457	594	455	43.3
8307	626	579	350	456	169	27.0
8308	653	586	355	461	191	29.2
8309	530	543	329	427	102	19.2
8310	839	540	327	425	413	49.2
8311	942	644	390	507	434	46.1
8312	1772	931	564	733	1038	58.6
					RMSE=455	RMSPE=37.8

EXHIBIT 5.7A

REGRESSION MODEL FORECASTING TESTS (8304-8312)
AIR FORCE 1-3 COHORTS

COHORT/EQUATION	ESTIMATION PERIOD/MODEL	FORECAST ERROR RMSPE	RMSE
HSDG			
F2	7601-8303	13.6	479
F3	7601-8303 with SCARCE3	12.7	447
F4	7811-8303	16.5	574
LF27R612[b]	7811-8303	12.9	452
HSSR			
F5	7811-8303	37.8	455
HSDG PLUS HSSR			
F6	7811-8303 without Applicants	16.7 6.1[a]	849 248[a]
F7	7910-8303 with Applicants	13.4[a]	552[a]

a Forecast test refers to 8304-8309 period.
b See Exhibit 5.10

EXHIBIT 5.6b

NAVY 1-3A FORECASTING TESTS
HSDG PLUS HSSR MODELS (7811-8303)

REGRESSION MODEL: EQUATION N5 (WITHOUT APPLICANTS)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	3613	5163	3305	4169	-556	-15.4
8305	3516	4847	3103	3914	-398	-11.3
8306	3921	5606	3588	4526	-605	-15.4
8307	4252	5999	3840	4844	-592	-13.9
8308	4697	5910	3783	4772	-75	-1.6
8309	4579	4979	3187	4020	558	12.2
8310	3843	4366	2795	3526	316	8.2
8311	4255	4209	2694	3398	857	20.1
8312	4149	4148	2655	3349	799	19.3

RMSE=575 RMSPE=14.1
RMSE=500[a] RMSPE=12.6[a]

REGRESSION MODEL: EQUATION N6 (WITH APPLICANTS @ 6)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	3613	4337	3514	3947	-334	-9.2
8305	3516	3817	3092	3473	42	1.2
8306	3921	4619	3742	4203	-282	-7.2
8307	4252	5072	4109	4615	-363	-8.5
8308	4697	4864	3940	4425	271	5.8
8309	4579	4498	3644	4093	485	10.6

RMSE=325 RMSPE=7.7

a Forecast test refers to 8304-8309.

EXHIBIT 5.6A

REGRESSION MODEL FORECASTING TESTS (8304-8312)
NAVY 1-3A COHORTS

COHORT/EQUATION	ESTIMATION PERIOD/MODEL	FORECAST ERROR RMSPE	RMSE
HSDG			
N2	7601-8303	14.3	414
N3	7811-8303	16.7	479
[b]	7706-8303 with composite of 4 leading regions	12.3	348
HSSR			
N5	7811-8303 without Applicants	30.1	453
HSDG PLUS HSSR			
N6	7811-8303 without Applicants	14.1	575
		12.6[a]	500[a]
N7	7910-8303 with Applicants	7.7[a]	325[a]

a Forecast test refers to 8304-8309 period.
b See Exhibit 5.10

EXHIBIT 5.5b

ARMY 1-3A FORECASTING TESTS
HSDG PLUS HSSR MODEL (7811-8303)

REGRESSION MODEL: EQUATION A5

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	5090	7123	4793	5885	-795	-15.6
8305	5009	7278	4898	6014	-1005	-20.0
8306	6049	7461	5021	6165	-116	-1.9
8307	5962	7287	4904	6021	-59	-1.0
8308	6400	6875	4627	5681	718	11.2
8309	5718	6167	4150	5096	621	10.9
8310	4774	5318	3578	4394	379	7.9
8311	5445	5868	3948	4848	596	10.9
8312	5032	5904	3973	4878	153	3.0
					RMSE=	RMSPE=
					585	11.0

EXHIBIT 5.5A

REGRESSION MODEL FORECASTING TESTS (8304-8312)
ARMY 1-3A COHORTS

COHORT/EQUATION	ESTIMATION PERIOD/MODEL	FORECAST ERROR RMSPE	FORECAST ERROR RMSE
HSDG			
A1	7601-8303	28.0	925
A2	7601-8303 Without Pop.	7.4	265
A3	8001-8303 With Missions	8.5	313
LA17R6[b]	7706-8303 with Leading-region 3543	7.9	271
HSSR			
A4	7811-8303	23.4	424
HSDG PLUS HSSR			
A5	7811-8303 without Missions	11.0	585
A6	8001-8303 with Missions	10.5	574
		7.0[a]	406[a]
A8	7910-8303 with Applicants	10.6[a]	590[a]

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a Forecast test refers to 8304-8309 period.
b See Exhibit 5.10

C. Tests With Alternative Regression Models

Alternative regression equations were estimated, and their forecast accuracy and error patterns examined. The forecasting errors are reported in Exhibits 5.5 - 5.8 for the HSDG, HSSR, and combination cohorts by Service.

1. Army Cohorts

As previously mentioned, the HSDG forecasts are dramatically improved by the exclusion of population from the model. The resulting error pattern is mixed. The inclusion of missions does not improve forecast accuracy. Forecasts based on a model estimated over a subset of the full period have larger errors. (This holds for all cohorts and Services.)

Underprediction of the HSSR cohort begins in June and gets steadily worse. One might suspect increased targetting of high school seniors during this period, a departure from the seasonal recruiting patterns implied by the decomposition analysis (see Exhibit). With only an intermittent series for HSSR missions available, it was not possible to test this hypothesis.

The combination (HSDG plus HSSR) cohort model produces underpredictions that begin in August and fluctuate at relatively high levels. The inclusion of the combined mission does not improve forecast accuracy nor alter the error pattern. The inclusion of applicants with a six month "lag" increases forecast error. Note that this comparison is confined to the 8304-8309 period because "future" applicants are only known for six months out.

EXHIBIT 5.4d

MARINE CORPS 1-3A FORECASTING TESTS
HSSR MODELS (7811-8303)

REGRESSION MODEL

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	791	943	635	779	11	1.3
8305	628	808	544	668	-40	-6.3
8306	1042	912	614	754	287	27.5
8307	945	935	629	773	171	18.0
8308	1013	859	578	710	302	29.8
8309	847	907	611	750	96	11.3
8310	941	1107	746	915	25	2.6
8311	887	1033	695	853	33	3.7
8312	848	1020	687	843	4	0.4

RMSE=155 RMSPE=15.6

UNIVARIATE MODEL

	STD ERROR	U90	L90	FCAST	ERROR	% ERROR
8304	61	848	606	727	64	8.0
8305	67	822	559	691	-63	-10.0
8306	71	1094	813	954	88	8.4
8307	76	1038	739	889	56	5.9
8308	80	1031	715	873	140	13.8
8309	84	1018	686	852	-5	-0.5
8310	88	1173	826	1000	-59	-6.2
8311	92	1223	862	1043	-156	-17.5
8312	95	1247	872	1060	-212	-25.0

RMSE=111 RMSPE=12.6

EXHIBIT 5.4C

AIR FORCE 1-3A FORECASTING TESTS
HSSR MODELS (7811-8303)

REGRESSION MODEL: EQUATION (not previously reported) (with SCARCE3)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	888	838	544	681	206	23.2
8305	903	716	465	582	320	35.4
8306	746	584	379	474	271	36.3
8307	465	435	282	354	110	23.6
8308	501	438	284	356	144	28.7
8309	386	388	252	316	69	17.9
8310	633	360	233	292	340	53.7
8311	715	499	324	405	309	43.2
8312	1326	661	429	537	788	59.4

RMSE=348 RMSPE=38.3

UNIVARIATE MODEL

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	888	881	543	691	197	22.1
8305	903	806	435	592	311	34.4
8306	746	630	301	436	310	41.5
8307	465	448	194	295	170	36.5
8308	501	401	158	252	249	49.7
8309	386	433	157	261	125	32.3
8310	633	488	164	284	349	55.1
8311	715	746	234	418	297	41.5
8312	1326	1093	321	592	734	55.3

RMSE=347 RMSPE=42.3

EXHIBIT 5.4b

NAVY 1-3A FORECASTING TESTS
HSSR MODELS (7811-8303)

REGRESSION MODEL: EQUATION N4

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1385	2297	1349	1784	-399	-28.8
8305	1195	1755	1030	1362	-167	-14.0
8306	1101	1327	779	1031	69	6.2
8307	1143	1136	667	882	260	22.7
8308	1323	1200	705	932	390	29.5
8309	1284	1086	638	843	440	34.3
8310	1451	1192	700	925	525	36.2
8311	1684	1217	714	944	740	44.0
8312	1811	1497	879	1162	648	35.8

RMSE=453 RMSPE=30.1

UNIVARIATE MODEL

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1385	1939	1156	1497	-112	-8.0
8305	1195	1585	763	1100	95	7.9
8306	1101	1521	621	972	129	11.7
8307	1143	1475	524	879	264	23.0
8308	1323	1798	566	1009	314	23.7
8309	1284	1710	482	908	376	29.2
8310	1451	2199	581	1131	320	22.0
8311	1684	2983	742	1488	193	11.4
8312	1811	3441	808	1667	144	7.9

RMSE=237 RMSPE=17.9

EXHIBIT 5.4a

ARMY 1-3A FORECASTING TESTS
HSSR MODEL (7811-8303)

REGRESSION MODEL: EQUATION A4

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1973	2705	2041	2358	-385	-19.5
8305	1728	2114	1594	1842	-114	-6.6
8306	1668	1479	1116	1289	378	22.7
8307	1580	1343	1013	1171	408	25.8
8308	1632	1353	1021	1180	451	27.6
8309	1573	1289	972	1124	448	28.5
8310	1718	1384	1044	1207	510	29.7
8311	2083	1710	1290	1490	592	28.4
8312	2241	1827	1378	1592	648	28.9

RMSE=424 RMSPE=23.4

UNIVARIATE MODEL

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1973	2659	1699	2125	-152	-7.7
8305	1728	2407	1277	1753	-25	-1.4
8306	1668	2048	942	1389	279	16.7
8307	1580	2186	970	1456	124	7.8
8308	1632	2410	1033	1577	55	3.3
8309	1573	2146	890	1382	191	12.1
8310	1718	2908	1133	1815	-97	-5.6
8311	2083	3745	1376	2271	-188	-9.0
8312	2241	4539	1579	2677	-436	-19.4

RMSE=208 RMSPE=10.8

EXHIBIT 5.3d

MARINE CORPS 1-3A FORECASTING TESTS
HSDG MODELS (7601-8303)

REGRESSION MODEL: EQUATION (not previously reported)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	831	1081	729	894	-63	-7.5
8305	852	1145	773	947	-95	-11.1
8306	1167	1903	1284	1575	-408	-34.9
8307	1028	1740	1174	1439	-411	-39.9
8308	1301	1805	1218	1494	-193	-14.8
8309	1188	1485	1002	1229	-41	-3.4
8310	962	1309	883	1083	-121	-12.5
8311	1195	1323	893	1095	99	8.2
8312	1002	1190	803	985	16	1.5

RMSE=214 RMSPE=19.6

UNIVARIATE MODEL

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	831	1112	671	864	-33	-3.9
8305	852	1296	714	962	-110	-12.9
8306	1167	2097	1120	1533	-366	-31.3
8307	1028	2398	1190	1689	-661	-64.2
8308	1301	2412	1119	1642	-341	-26.2
8309	1188	2273	1007	1513	-325	-27.3
8310	962	1720	726	1118	-156	-16.2
8311	1195	2136	858	1354	-159	-13.3
8312	1002	1866	717	1157	-155	-15.4

RMSE=312 RMSPE=28.7

EXHIBIT 5.8b

MARINE CORPS 1-3 FORECASTING TESTS
HSDG PLUS HSSR MODELS (7601-8303)

REGRESSION MODEL: EQUATION M2 (HSDG)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1185	1496	1019	1243	-58	-4.8
8305	1223	1605	1093	1334	-110	-9.1
8306	1854	2689	1831	2234	-380	-20.5
8307	1648	2703	1841	2246	-598	-36.3
8308	2112	2634	1794	2189	-77	-3.6
8309	1981	2314	1576	1923	57	2.9
8310	1521	1924	1310	1599	-78	-5.1
8311	1748	1928	1315	1602	145	8.3
8312	1546	1715	1168	1425	120	7.8

RMSE=235 RMSPE=14.0

REGRESSION MODEL: EQUATION M4 (HSSR)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	1345	1580	1068	1309	36	2.7
8305	1145	1328	898	1101	44	3.8
8306	1817	1599	1080	1324	493	27.1
8307	1697	1525	1031	1264	433	25.5
8308	1803	1413	955	1171	632	35.0
8309	1566	1621	1095	1343	223	14.2
8310	1620	1773	1198	1469	151	9.3
8311	1567	1671	1129	1384	183	11.7
8312	1547	1666	1126	1380	167	10.8

RMSE=328 RMSPE=18.8

EXHIBIT 5.8c

MARINE CORPS 1-3 FORECASTING TESTS
HSDG PLUS HSSR MODEL (7811-8303)

REGRESSION MODEL: EQUATION M5 (WITHOUT APPLICANTS)

	ACTUAL	U90	L90	FCAST	ERROR	% ERROR
8304	2530	2842	2051	2427	103	4.1
8305	2368	2729	1969	2331	37	1.6
8306	3671	4149	2994	3542	129	3.5
8307	3345	4418	3188	3772	-427	-12.8
8308	3915	3942	2845	3366	549	14.0
8309	3547	3892	2809	3324	223	6.3
8310	3141	3330	2403	2844	297	9.5
8311	3315	3311	2389	2827	488	14.7
8312	3093	3185	2298	2720	373	12.1

RMSE=338 RMSPE=9.9

2. <u>Navy Cohorts</u>

The HSDG forecasts are characterized by increasing overprediction during the April to August period, and followed by a mixed pattern. (This model would have sounded a monitoring alert in June through August; see next chapter.)

With regard to the HSSR cohort, there is steadily increasing under prediction beginning in June.

For the combined cohort, there is constant overprediction through July, followed by constant to increasing underprediction through December. This seems to suggest a policy reassessment to boost recruiting. Unlike the other Services, the inclusion of applicants (with a six month lag) markedly improved forecasting accuracy and also produced a mixed error pattern.

3. <u>Air Force Cohorts</u>

There is a tendency to underpredict the HSDG cohort over the September to December 1983 period. Apparently towards the end of CY 1983 the Air Force began "free flowing"; such a policy change is not reflected in the model. If the December error is excluded, the overall average error falls below ten percent. Inclusion of a proxy to pick up a shortage of jobs vis-a-vis goals (during the estimation period), indirectly improves forecast error marginally.

The HSSR model produces chronic underpredictions that become increasingly worse. Part of the answer may lie in the free flowing.

Looking at the combined cohort, the errors are reasonably small and the pattern mixed through September, followed by large underprediction to year's end. Forecasts with applicants included in the model are noticeably worse.

4. Marine Corps Cohorts

For the HSDG cohort there is a tendency to overpredict the April through August period, with especially large errors in June and July. The errors are relatively small and mixed during the remainder of the period.

The HSSR model produces chronic under predictions that rise to an August peak and then decline.

Relatively small, chronic underpredictions characterize the combination cohort forecasts. The inclusion of applicants accentuates the underprediction.

D. Leading Regions: Detection and Forecasting Tests

Empirical work was carried out to identify regional enlistment leaders, if they exist at all, for each of the Services. In this exploratory phase, the work focused on the 1-3A HSDG cohorts with regional enlistments defined for each Service in terms of Air Force recruiting squadrons. The analyses were conducted over the January 1976 to September 1983 period.

The research question is whether there is a relationship between current national-level enlistments and regional-level enlistments at earlier points in time. We measured the relationship with correlation coefficients. The obfuscating effects of seasonal movements were controlled by taking the ratio of the current value to its value twelve months previous as the observation for correlation analysis.

In conducting the correlation analysis, we looked at leads from one to twelve months, with a focus on four to six months out. For each of these windows, we identified those squadrons that consistently ranked among the top six or so. These are the best candidates for leading districts and are listed in Exhibit 5.9. We also indicate the range of

EXHIBIT 5.9

LEADING REGIONAL CANDIDATES
(BY AIR FORCE RECRUITING SQUADRONS)

	ARMY	NAVY	AIR FORCE	MARINE CORPS
	3512	3513	3530	3554
	3537	3552	3554	3561
	3543	3563	3562	3562
	3554	3566	3567	
CORRELATIONS				
4 MONTHS OUT	.68 - .70	.80 - .83	.41 - .43	.61 - .64
5 MONTHS OUT	.64 - .68	.83 - .86	.43 - .45	.56 - .61
6 MONTHS OUT	.60 - .64	.77 - .80	.31 - .38	.52 - .53

AFRS SQUADRON HEADQUARTERS:

3512 Westover AFB, Maine
3513 Hancock Field, New York
3537 Shaw AFB, South Carolina
3543 Omaha, Nebraska
3550 Indianapolis, Indiana
3552 Wright Patterson AFB, Ohio
3554 Selfridge Ang, Michigan
3561 Seattle, Washington
3562 Norton AFB, California
3563 Mather AFB, California
3566 Travis AFB, California
3567 Lowry AFB, Colorado

correlations for windows at four, five, and six months out. Generally speaking, the highest correlations were registered in the Navy and the lowest in the Air Force; the Navy is also the most geographically balanced.

One squadron — 3554, the state of Michigan excluding the upper penninsula — turned out to be a top candidate for the Army, Air Force, and Marine Corps; another one — 3562, Arizona and southern California — turned out to be a top candidate for the Air Force and Marines.

These candidates were selected because they had consistently higher correlations (than the other regions) with national-level enlistments at "leads" of four to six months. These candidates were included in HSDG cohort models in order to determine if they improve forecasting accuracy. The focus was on a six-month window.

Leading region variables were defined in two ways: first, as the logarithm of regional enlistments lagged six months; and second, as the logarithm of the ratio of current (t) to last year (t-12) regional enlistments, also with a lag of six months. The latter formulation is devised as a precaustion against the potentially obfuscating effects of the different seasonal cycle of a six-month lagged variable. In addition to separate regional variables, composites were tested for several cohorts.

Exhibit 5.10 summarizes the regression results and the forecasting tests carried out thus far. In brief, regional leaders do not seem to be an especially promising avenue. As variables in the model, the estimated coefficients were seldom statistically significantly different from zero. In the forecasting tests there were only two instances in which forecasts with a leading region were better (Air Force) and the error reductions were modest. Some additional testing remains before regional leaders can be ruled in or out.

EXHIBIT 5.10

LEADING REGION ESTIMATION (7706-8303) AND FORECASTING TESTS (8304-8309)

REGRESSION/REGION#/LAG	COEFF.	T-VALUE	EST. PERIOD RMSE	FORECAST PERIOD RMSPE	RMSE
ARMY HSDG 1-3A					
LA03R6 3512 (6)	.067	1.35	.134	9.0	306
LA15R6 3537 (6)	.031	.48	.136	8.7	299
LA17R6 3543 (6)	.040	.61	.136	7.9	271
LA27R6 3554 (6)	.033	.42	.136	8.5	294
COMPOSITE (6)	.064	.89	.136	8.6	291
w/o LEADING REGIONS (7706-)	----	----	.135	8.3	294
NAVY HSDG 1-3A					
COMPOSITE: (6) 3513, 3552, 3563, 3566	.087	1.37	.100	12.3	348
w/o LEADING REGIONS (7704-)	----	----	.109		
AIR FORCE HSDG 1-3					
LF23R612 3550 (6/18)	.060	1.49	.120	14.6	497
LF27R612 3554 (6/12)	.008	.15	.134	12.9	452
w/o LEADING REGIONS (7706-)	----	----	.121	15.5	538
MARINE CORPS HSDG 1-3					
LM27L6 3554 (6)	.07	1.06	.103	24.5	395
LM30L6 3561 (6)	.03	.50	.095	21.5	350
LM31L6 3562 (6)	-.01	-.22	.095	21.4	350
w/oLEADING REGIONS (7811-)	----	----	.096	18.1	298

E. Forecasting Feasibility

Stringent out-of-sample forecasting tests were conducted over the April-December 1983 period. The forecasts have been evaluated in terms of accuracy and pattern.

By reasonable standards the forecasting accuracy demonstrated is acceptable:

- It is better (worse) with the HSDG (HSSR) cohorts because the estimation period series is longer (shorter).

- There are differences by Services.

- The regression models have fit better for the HSDG cohorts (except for Navy); the RMSPE's range from 7 to 14 percent. The univariate time-series models have fit better for the HSSR cohorts; the RMSPE's range from 11 to 18 percent (excluding the Air Force at 42 percent).

Examination of the error patterns indicates that program and policy information is missing. The HSSR forecasts are characterized by underprediction, suggesting that recruiting responses were underway during the test period. Presumably, in a "live" situation, this kind of information would be flowing regularly into EEWS.

Forecasting tests were conducted on the combination HSDG-plus-HSSR cohort. Forecast accuracy is comparable to that achieved for the HSDG cohort; evidently there are advantages to a combined model as well as offsetting forecast errors. The underprediction characteristic of the HSSR forecasts appears in the combination cohorts, growing towards the end of the period. Indeed, if only six-month forecasting tests are conducted, the RMSPE's range from only 6 to 13 percent (see Exhibit 5.11).

Some testing was also conducted to determine if enlistments from

EXHIBIT 5.11

REGRESSION MODEL FORECASTING TEST (8304-8312)
HSDG PLUS HSSR COHORT SUMMARY

SERVICE/MODEL	ERROR PATTERN DESCRIPTION	FORECAST ERROR RMSPE	FORECAST ERROR RMSE
ARMY 1-3A			
7811-8303 without missions		11.0	585
8001-8303 with missions	Underprediction starts in August and fluctuates; inclusion of missions does not affect pattern.	10.5	574
7910-8303 without applicants		10.2	551
		7.0[a]	406[a]
7910-8303 with applicants @6		10.6[a]	590[a]
NAVY 1-3A			
7811-8303 without applicants	Constant overprediction thru July, then constant underprediction; produces mixed pattern.	14.1	575
		12.6[a]	500[a]
7811-8303 with applicants @6		7.7[a]	325[a]
AIR FORCE 1-3A			
7811-8303 without applicants	Mixed pattern thru September, then large underprediction.	16.7	849
		6.1[a]	248[a]
7910-8303 with applicants @6		13.4[a]	552[a]
MARINE CORPS 1-3A			
7811-8303 without applicants	Small chronic underprediction.	9.9	338
		8.5[a]	306[a]
7910-8303 with applicants @6		11.1[a]	407[a]

[a] Forecast test refers to 8304-8309 period.

regional "leaders" could be utilized to improve forecasting accuracy. Four, five, and six month leads were tested. The preliminary results were not encouraging.

Finally, we tested to determine whether the contracts forecasting model could be improved by utilizing information at the application stage of the enlistment pipeline. Applicant flows six months prior were included in the model. Only for the Navy were the forecasts noticeably improved.

CHAPTER VI

EEWS CONCEPTUAL DESIGN

The findings of the literature review (Volume II) and of the empircal work reported in the preceding chapters of this volume enable us to design a prototype EEWS (see Exhibit 6.1). Like other early warning systems, it consists of three components: computerized monitoring, human assessment, and policy response.

A. Computerized Monitoring

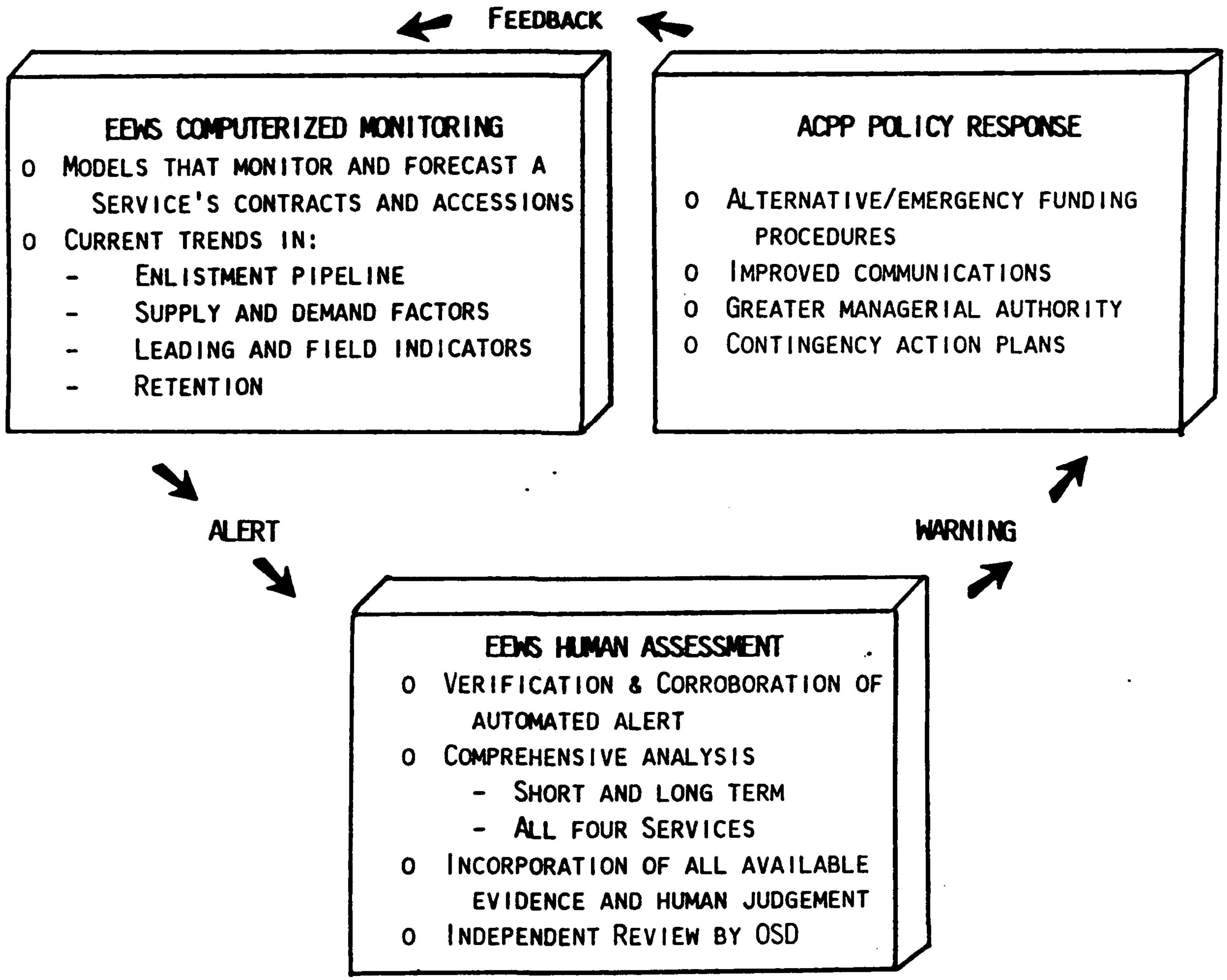
For each Service, the Computerized Monitoring Component would include regression models for forecasting high-quality HSDG's and HSSR's, and a univariate model that would provide forecasts of unemployment. In addition, the automated system would include an extensive monthly data base on the enlistment pipeline, supply and demand factors, leading and field indicators, and retention.

The Computerized Monitoring Component would signal a monitoring alert when the flow of gross contracts (HSDG's plus HSSR's) in the current month failed to match, within a 90 percent confidence interval, the amount forecasted. It would signal a "forecasting alert" if, in any of the next nine months, the forecast of high quality net contracts was below the goal for net contracts. This is equivalent to sounding an alert if the probability of making goal is less than fifty percent in any future month.

The Computerized Monitoring Component would generate a Monthly Report on the Status of Recruiting, for each Service, that would include trends in variables as well as forecasts of contracts and unemployment. This report would be used within the Service by the Human Assessment Group for alert verification and corroboration. The extensive data included in the monthly report plus the report of the Human Assessment Group should provide enough credible evidence to convince OSD, OMB and

EXHIBIT 6.1

EEWS AND ACPP CONCEPTUAL FRAMEWORK



Congressional staffers that an alarm is valid.

A sample organization for the monthly report is presented in Exhibit 6.2. It consists of four sections. Section 1 gives trends in contracts, providing an historical perspective for evaluating forecasts. Section 2 presents the forecasts, and, in comparing them with goals, establishes whether or not there is an alert status. Section 3 reports trends in leading indicators, applicants, leads, etc; examination of these would corroborate the direction of the forecasts. Section 4 includes data on trends in supply factors, goals, and policies. This information would be used to evaluate whether or not a downturn in enlistments were the result of Service policy changes, thereby reducing the likelihood of false alarms. EEWS users could choose to generate part or all of the monthly report, and could also choose from a variety of graphic or tabular presentations.

B. The Human Assessment Group

Once an alert is signaled by the Computerized Monitoring Component, a working-level group of knowledgeble experts within the Service would meet to verify that an alert had taken place: they would use the data provided by the EEWS and any other available sources, as well as expert judgement, to verify the alert. If the alert were genuine, they also would determine and describe the nature of the recruiting problem facing the Service over the next five years. This assessment of long-term recruiting conditions would be accomplished with the use of POM planning models such as the ESP which is used frequently by OSD, the RPAM created for the Air Force, and the RA developed for the Army. A list of the tasks to be undertaken by the Human Assessment Group appears in Exhibit 6.3.

The human assessment process could move through levels of review, incorporating both working-level and senior-level personnel in the Services and OSD. The organizational structure, staffing, and administrative procedures remain to be developed. However, using the

EXHIBIT 6.2

SAMPLE ORGANIZATION

of

MONTHLY REPORT ON STATUS OF SERVICE RECRUITING

Section 1: RECENT TRENDS IN SERVICE CONTRACTS
October 1979-present
- To give historical perspective

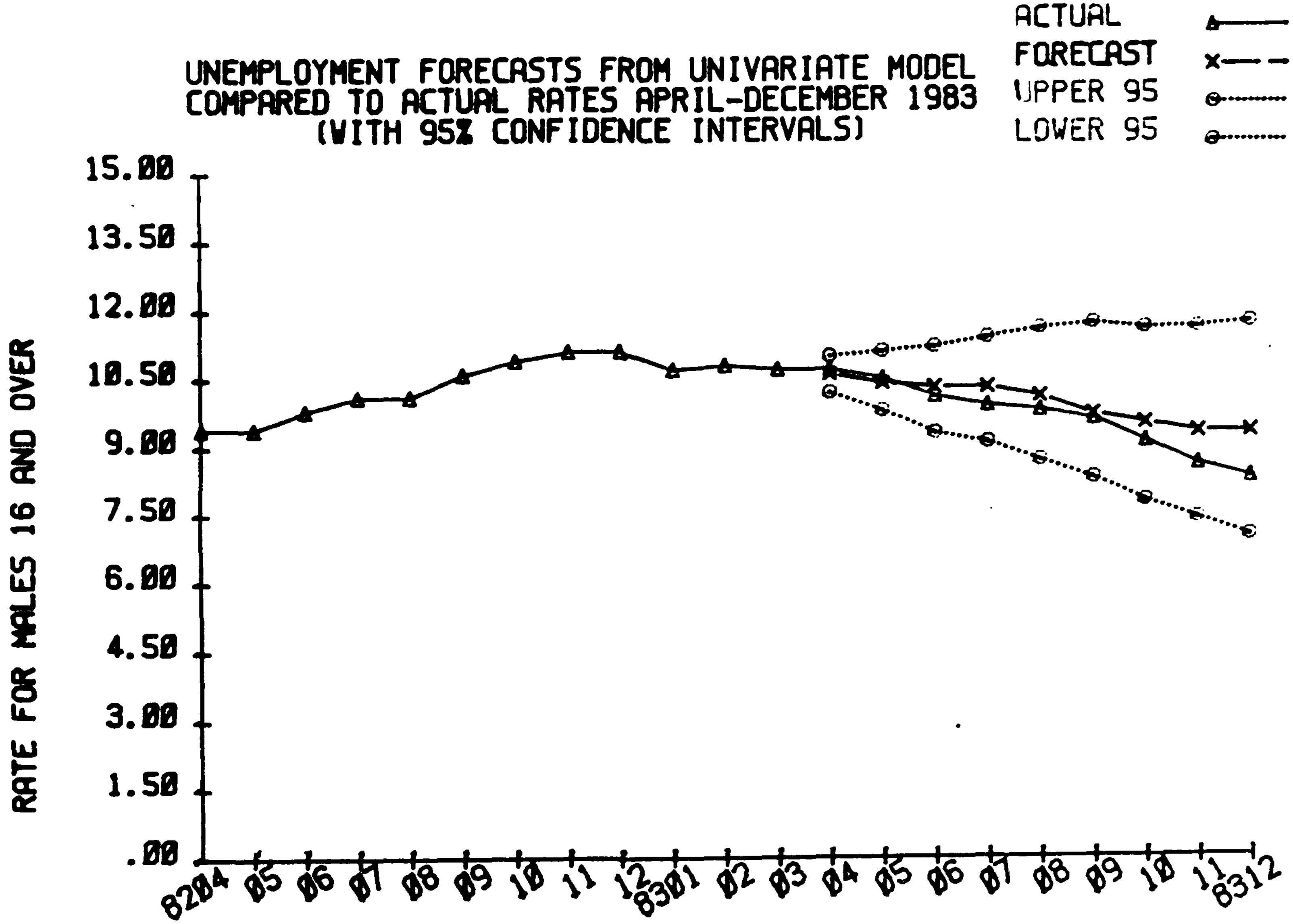
Section 2: FORECASTS OF SERVICE CONTRACTS VERSUS CONTRACT GOALS
- To signal alerts and describe problem

Section 3: TRENDS IN LEADING AND CURRENT INDICATORS
October 1979-present
- To provide supporting evidence

Section 4: TRENDS AND PROJECTIONS OR ASSUMPTIONS REGARDING SUPPLY FACTORS
October 1979-present
- To guard against false alarms

continued

EXHIBIT 7.2


UNEMPLOYMENT FORECASTS FROM UNIVARIATE MODEL
COMPARED TO ACTUAL RATES APRIL-DECEMBER 1983
(WITH 95% CONFIDENCE INTERVALS)
ACTUAL
FORECAST
UPPER 95
LOWER 95
RATE FOR MALES 16 AND OVER
15.00
13.50
12.00
10.50
9.00
7.50
6.00
4.50
3.00
1.50
.00
8204 05 06 07 08 09 10 11 12 8301 02 03 04 05 06 07 08 09 10 11 8312

To demonstrate this capability let us assume that an EEWS was operating in April 1983 using the models our research developed for forecasting unemployment and contracts. Recruiting started to decline in the fourth quarter of 1983. Would the system have forecasted the declines? The answer is yes: The EEWS would have forecasted the declines and signaled an alert with sufficient time to take corrective actions if this were deemed necessary.

First, the EEWS would have forecasted the declines in unemployment that preceded the declines in contracts (Exhibit 7.2.) This is important evidence that a change in the market was going to take place. Second, the system would have reported a significant decline in the flow of high-quality gross contracts (Exhibits 7.3a-d). Third, it would have signalled a deterioration in net contracts relative to estimates of high-quality net recruiting goals (Exhibit 7.4). (To signal an alert the system must compare forecasts of high-quality net contracts and high-quality net recruiting goals. The models forecast high-quality NPS male gross contracts while the goals of the Services are usually given for total contracts (with the exception of the Army). To make comparisons between forecasts and goals, we must adjust forecasts for DEP attrition and goals for inclusion of other cohorts, e.g., non HSDG's, females, etc. For the methodology used to derive net goals and forecasts of net contracts for high-quality NPS male HSDG's see Exhibit 7.5.)

The system would have reported a deterioration in the ratio of goals to high-quality net contracts for all four Services in the latter part of 1983: For the Army, Navy, and Air Force, the ratio was less than 100 percent in 9 instances September through December 1983. The deterioration in the ratio means that the probability of achieving goal is declining for all Services. Given forecasts of declines in both unemployment and contracts, and in the probability of making goal for all Services, the April reports for the four Services, taken together, would have sounded a strong alert to carry out assessments of the recruiting market. (See Exhibits 7.6a-d.)

VARIABLES PRESENTLY CONTAINED IN THE EEWS DATABASE (continued)

VARIABLE	SERIES BEGINS	SOURCE	UPDATING
LEADING ECONOMIC INDICATORS (cont.)			
New private housing units begun			
Index of stock prices, 500 common stocks			
Composite of twelve leading indicators			
POPULATION (1 variable)	7601	DMDC	Annual update
All male youth 17-21 yrs.			
MILITARY PAY (1 variable)	7601	DOD Pay Table weighted by time + grade	1 week
First year military pay			
CIVILIAN PAY (1 variable)	7601	CPS	5-13 weeks
Median weekly earnings of male full-time workers 16-19 years			

REQUESTED: DEP ATTRITION, ADVERTISING EXPENDITURES, LEADS, AND ADDITIONAL POLICY CHANGES.[b]

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a For exact definitions of recruiter and goal variables, see Exhibit 3.10, pg.65.

b Selected data on policy changes are presently included. These variables are listed and defined in Exhibit 3.10, pg.66.

VARIABLES PRESENTLY CONTAINED IN THE EEWS DATABASE (continued)

VARIABLE	SERIES BEGINS	SOURCE	UPDATING
UNEMPLOYMENT (3 variables)			
Unemployment rate for civilian labor force males, 16 yrs. and over: Original Series	7201	BLS	1 week
Same as above: Seasonally Adjusted	"	"	"
Same as above for males 16-19: Seasonally Adjusted	"	"	"
UNEMPLOYMENT FORECASTS (4 variables)			
Total civilian unemployment	8301	BEA CBO GSU	13-17 weeks 13-17 weeks 3-4 weeks
Total male civilian unemployment	8304	ERL	1 week
LEADING ECONOMIC INDICATORS (10 variables)	7001	Business Conditions Digest	3-4 weeks
Average workweek, production workers, manufacturing			
Average weekly overtime, production workers, manufacturing			
Average weekly initial claims, state unemployment insurance			
Index of help-wanted advertising			
Industrial production, consumer goods			
New orders, durable goods			
New orders, consumed goods			
Contracts and orders, plant and equipment			
New orders, capital goods, nondefense			

EXHIBIT 7.1

VARIABLES PRESENTLY CONTAINED IN THE EEWS DATABASE

VARIABLE	SERIES BEGINS	SOURCE	UPDATING LAG
GROSS CONTRACTS — NPS Males (36 variables, 9 per Service)		DMDC	3-4 weeks
HSDG's: 1-3A's, 3B's, 4s and 5s	7601		
NHSG's: 1-3A's, 3B's, 4s and 5s	7601		
HSSR's: 1-3A's, 3B's, 4s and 5s	7811		
APPLICANTS -- NPS Males First Time Production Tested (36 variables, 9 per Service)		DMDC	3-4 weeks
HSDG's: 1-3A's, 3B's, 4s and 5s	7910		
NHSG's: 1-3A's, 3B's, 4s and 5s	7910		
HSSR's: 1-3A's, 3B's, 4s and 5s	7910		
GOALS (4 variables)[a]			
Army Net Contract Mission	8001	Army/ USAREC	1 week
Navy Total New Contract Objectives	8110	Navy/ NRC	"
Air Force Net Reservation Goals	7601	Air Force/ RS	"
Marine Corps Regular Male Goals	7601	Marine Corps/HQTRs	"
RECRUITERS (4 variables)[a]			
Army Recruiters	7601	Army/USAREC	"
Navy Recruiters	"	Navy/NRC	"
Air Force Recruiters	"	AFRS	"
Marine Corps Recruiters	"	M.C./HQTRs	"

the required data as possible, given time and budget constraints. We also investigated the question of updating lags, i.e. the number of weeks after a given month until data for that month would be available.

A summary of this research is given in Exhibit 7.1. Required data on the enlistment pipeline, supply and demand factors, and leading indicators are available. Indeed, most have already been collected. The exceptions are supporting data on DEP attrition, retention, advertising expenditures, and leads. Some data on policy changes have been collected, but more are required and have been requested. Policy change information is especially important for evaluating monitoring alerts and preventing false alarms.

Most required data are available within approximately four weeks after the end of a month. The exceptions are forecasts of unemployment from two outside sources and data on civilian earnings. However, we do not believe these updating lags present serious problems. Two sources of unemployment forecasts (GSU and ERL) are available on a monthly basis; and, because civilian earnings of youth change slowly, we can forecast values when necessary based on recent trends and changes in the economy. Therefore, we conclude that the require data are available and it is possible to update the EEWS data base in a timely fashion. While our research indicates that data updating lags should not be a problem, it remains to be shown exactly how long monthly updating will take. This will be accomplished in Phase II of the study.

B. Will the Forecasting Models Provide Enough Lead Time For Taking Corrective Action?

The research we presented in Chapter V showed that in the test period, April - December 1983, our preliminary models provided relatively accurate forecasts of unemployment and enlistments, and did so with a lead time of nine months. These encouraging results suggest that it may be possible to accurately assess the near-term status of recruiting.

CHAPTER VII

FEASIBILITY OF DEVELOPING COMPUTERIZED MONITORING AND HUMAN ASSESSMENT COMPONENTS

There are a number of major issues that must be addressed in assessing the feasibility of an EEWS and ACPP.

1. Will the required data for the EEWS be available to yield an objective, comprehensive, and credible analysis in a timely fashion?

2. Will the forecasting models yield sufficient lead time for taking corrective action?

3. Could human assessment of a computerized alert be performed expediently?

4. Is automation of the EEWS technically possible and practical?

5. Will the current Budgeting/Programming Process Tolerate the changes the ACPP would bring?

The knowledge provided by the research described in the preceding chapters of this volume of the study report and in Volumes II and III, has prepared us to answer questions 1, 2, and 3. The feasibility of developing an automated system (question 4) is fully discussed in Volume V. The conceptual design of an ACPP and an assessment of its feasibility (question 5) is given in Volume VI.

A. Will Required Data Be Available In a Timely Fashion?

To determine whether the data required to fuel the forecasting engine, operate the alert functions, and enable the delivery of a monthly report would be available in a timely fashion, we specified the EEWS's data requirements. To test feasibility, we actually collected as many of

EXHIBIT 6.4

REPORT OF EEWS ASSESSMENT GROUP

SAMPLE FORMAT

WORKING ASSUMPTIONS:	Resources and goals from Services' POM's Common set of forecasts/what-if-scenarios re: economy and policies Description of models and methods used Differences between POM and current working assumptions
SHORT-TERM OUTLOOK:	
LONG-TERM OUTLOOK:	
RECOMMENDATION:	Warning or no warning Whether or not Accession Crisis Prevention Process should be implemented
QUALIFICATIONS:	Duration, scope, dimensions of problem

informational resources and analytical methodologies described above, an assessment should be completed and a report prepared within four weeks of the initial alert. The report would provide an assessment of the short and long-term outlook for recruiting and a recommendation regarding whether or not to issue a warning and activate the policy response mechanism -- the ACPP. The group's report would describe the magnitude and timing of enlistment problems, and contain an appendix documenting all of the methods, models, or data used in the assessment. Valuable time could be saved if the appendix were written in advance of an alert. A sample report format is given in Exhibit 6.4.

C. The Accession Crisis Prevention Process (ACPP)

The ACPP is the EEWS's policy response component: it would enhance the ability of the Services to fund required resources and take necessary actions in a timely manner. Key elements of the ACPP are greater managerial authority, emergency funding procedures, and contingency action plans.

Upon activation of the ACPP by the Human Assessment Group, a working-level committee sharing some members in common with the Group, would meet to begin the Offline Adjustment Process (OAP). This would include the development and recommendation of policy actions. Here contingency action plans, partially worked out in advance, would save time. The report of the Human Assessment Group would provide a description of the recruiting problems that would have to be addressed. This knowledge would be essential to accurate identification of the magnitude and timing of the response, and in providing justification to OSD, OMB and Congrssional staffers. In addition to the OAP, the ACPP would provide other procedures which would greatly facilitate timely application of resources to meet immediate needs.

The ACPP plays a critical role in bringing resources to bear on enlistment problems in a timely fashion, thereby complementing the other two components of the EEWS. Volume VI of this report provides a detailed discussion of the concpetual design of the ACPP.

EXHIBIT 6.3

TASKS FOR ASSESSMENT GROUP
(Upon Alert)

- Verify data and alert status
- Review EEWS short-term forecasts
- Obtain and review long-run forecasts from existing POM planning models, e.g., ESP, RPAM, RA
- Consider factors not included in models
- Assess short and long-term outlook for recruiting
- Report results

Figure 9: ANALYSES OF **DELAYED ENTRY POOL**: GROSS INFLOWS, STOCK, ATTRITION

Figure 10: **DISTRICT-LEVEL** GROWTH RATE STATISTICS: AVERAGE GROWTH RATE RELATIVE TO SAME MONTH IN PREVIOUS YEAR; NUMBER GROWING VS NUMBER DECLINING

SECTION FOUR

TRENDS AND PROJECTIONS OR ASSUMPTIONS REGARDING SUPPLY FACTORS

Figure 1: NATIONAL TRENDS IN ALL MALE YOUTH POPULATION

Figure 2: CIVILIAN AND MILITARY PAY

- o GROWTH RATE OF EACH
- o RATIO BETWEEN THE TWO
- o TRENDS AND FORECASTS OF RELATIVE MILITARY PAY BY MONTH THIS YEAR VERSUS SAME MONTH LAST YEAR

Figure 3: RECRUITING RESOURCES

- o RECRUITERS AND ADVERTISING EXPENDITURES BY YEAR
- o TRENDS AND FORECASTS OF RECRUITERS BY MONTH THIS YEAR VERSUS SAME MONTH LAST YEAR
- o TRENDS AND FORECASTS OF ADVERTISING EXPENDITURES BY MONTH THIS YEAR VERSUS SAME MONTH LAST YEAR

Figure 4: GOALS BY MONTH MARCH 1983-September 1984

- o TOTAL
- o NPS MALE HIGH QUALITY
- o NPS FEMALE HIGH QUALITY
- o PRIOR SERVICE

Figure 5: TIME LINE RECORD OF POLICY CHANGES TO EXPAND/CONTRACT FLOW OF CONTRACTS

SECTION THREE

RECENT TRENDS IN LEADING AND CURRENT INDICATORS

continued

SECTION TWO
FORECASTS OF SERVICE CONTRACTS VERSUS CONTRACT GOALS

continued

MONTHLY REPORT ON STATUS OF SERVICE RECRUITING

EXAMPLES OF CONTENTS

(Time Profile Graphs or Bar Charts with Data Base Tables Available)

SECTION ONE

RECENT TRENDS IN ARMY CONTRACTS

Figure 1: RECENT TRENDS IN **ENLISTMENT CONTRACTS** FOR THE SERVICE

- o All NPS Male Contracts
- o All NPS Female Contracts
- o All Prior Service Contracts
- o Total Contracts

Figure 2: RECENT TRENDS IN **NPS MALE** ENLISTMENT CONTRACTS FOR THE SERVICE

- o HSDG by Mental Category
- o Seniors by Mental Category
- o NonHSDG by Mental Category
- o Total NPS Male Contracts

Figure 3: RECENT TRENDS IN **PERCENTAGE COMPOSITION** OF NPS MALE ENLISTMENT CONTRACTS FOR THE SERVICE (by educational and mental-category cohort)

Figure 4: RECENT TRENDS IN **HIGH QUALITY** NPS MALE ENLISTMENT CONTRACTS FOR THE SERVICE (by educational and mental-category cohort)

Figure 5: RECENT TRENDS IN **HIGH QUALITY** NPS MALE ENLISTMENT CONTRACTS **AS A PERCENT OF TOTAL MALE CONTRACTS** FOR THE SERVICE (by educational and mental-category cohort)

continued

EXHIBIT 7.3a

FORECASTS OF ARMY NPS MALE GROSS CONTRACTS
COMPARED TO ACTUALS FOR APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)

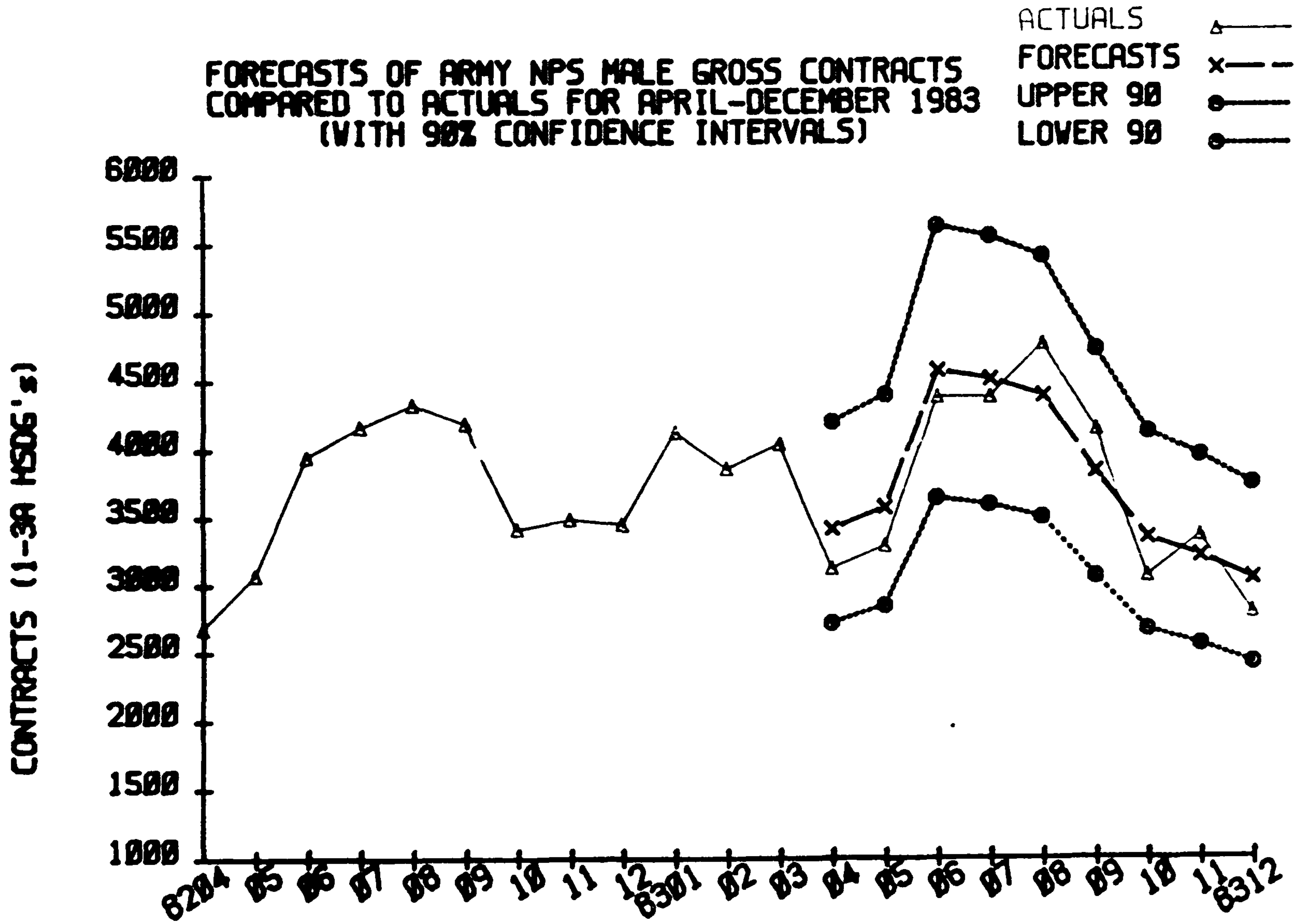


EXHIBIT 7.3b

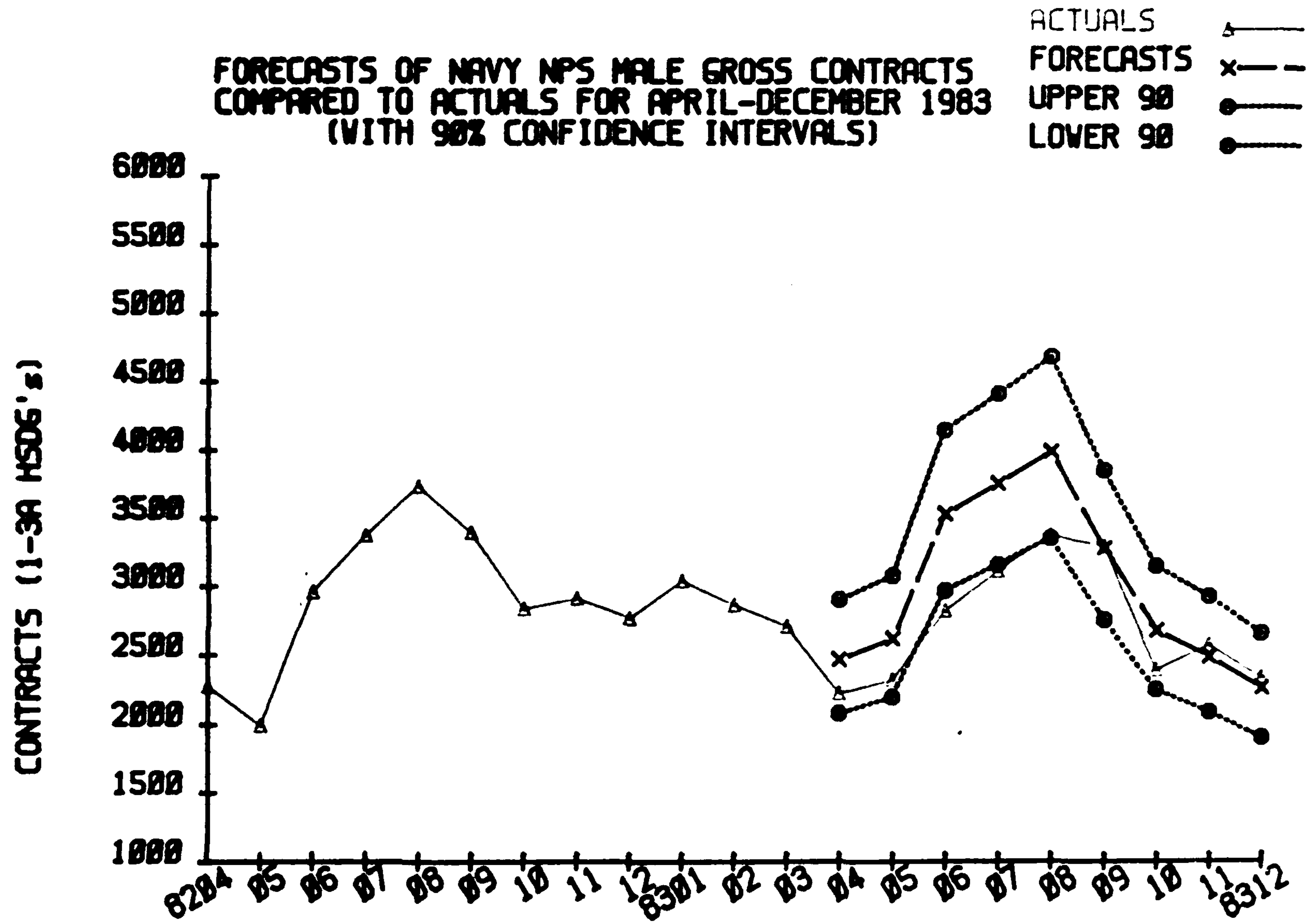

FORECASTS OF NAVY NPS MALE GROSS CONTRACTS
COMPARED TO ACTUALS FOR APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)
ACTUALS
FORECASTS
UPPER 90
LOWER 90
CONTRACTS (1-3A HSDG's)
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
8204
05
06
07
08
09
10
11
12
8301
02
03
04
05
06
07
08
09
10
11
8312

EXHIBIT 7.3c

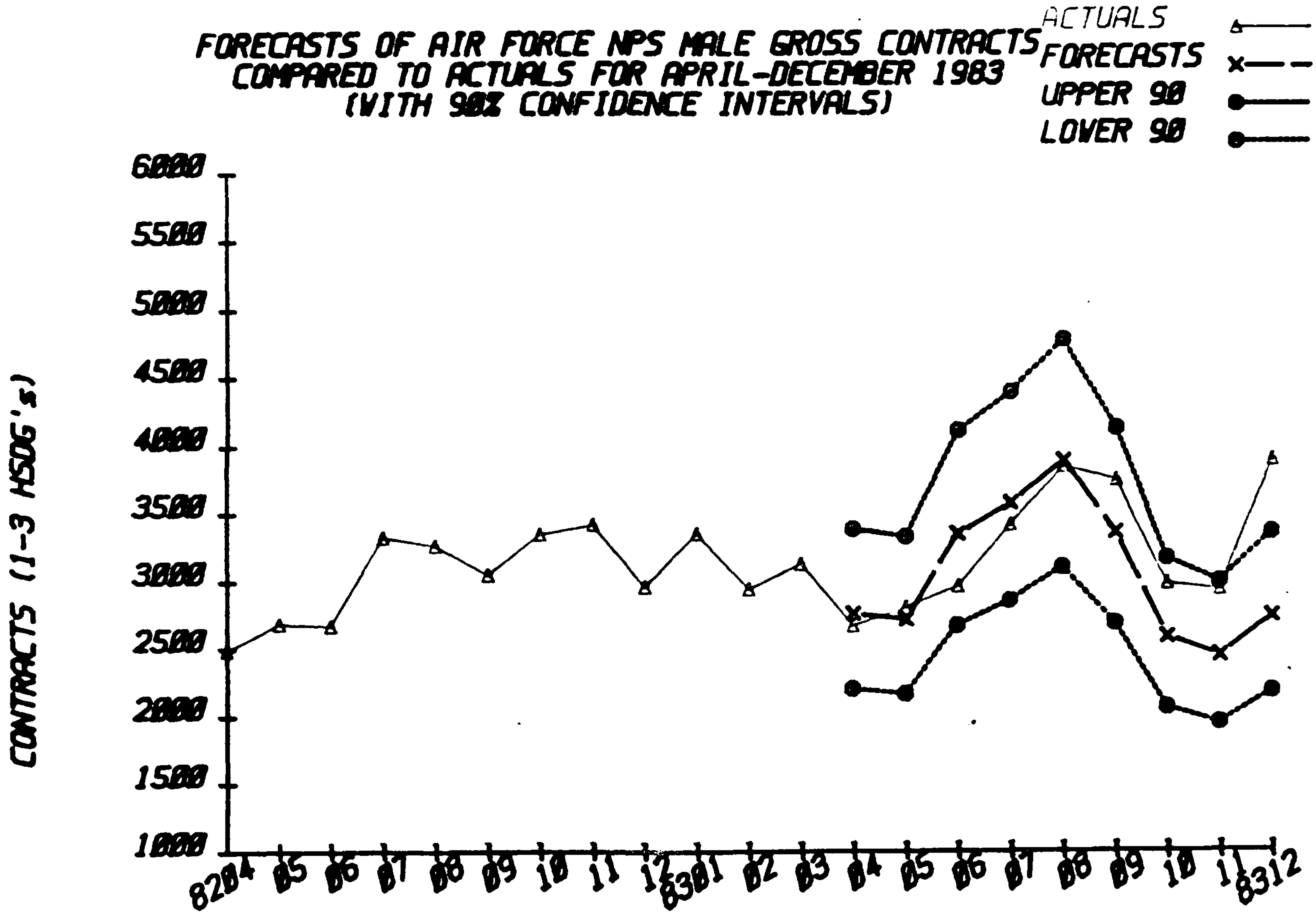

FORECASTS OF AIR FORCE NPS MALE GROSS CONTRACTS
COMPARED TO ACTUALS FOR APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)
ACTUALS
FORECASTS
UPPER 90
LOWER 90
CONTRACTS (1-3 HSDG's)
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
8204
05
06
07
08
09
10
11
12
8301
02
03
04
05
06
07
08
09
10
11
8312

EXHIBIT 7.3d

FORECASTS OF MARINE CORPS NPS MALE GROSS CONTRACTS
COMPARED TO ACTUALS FOR APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)

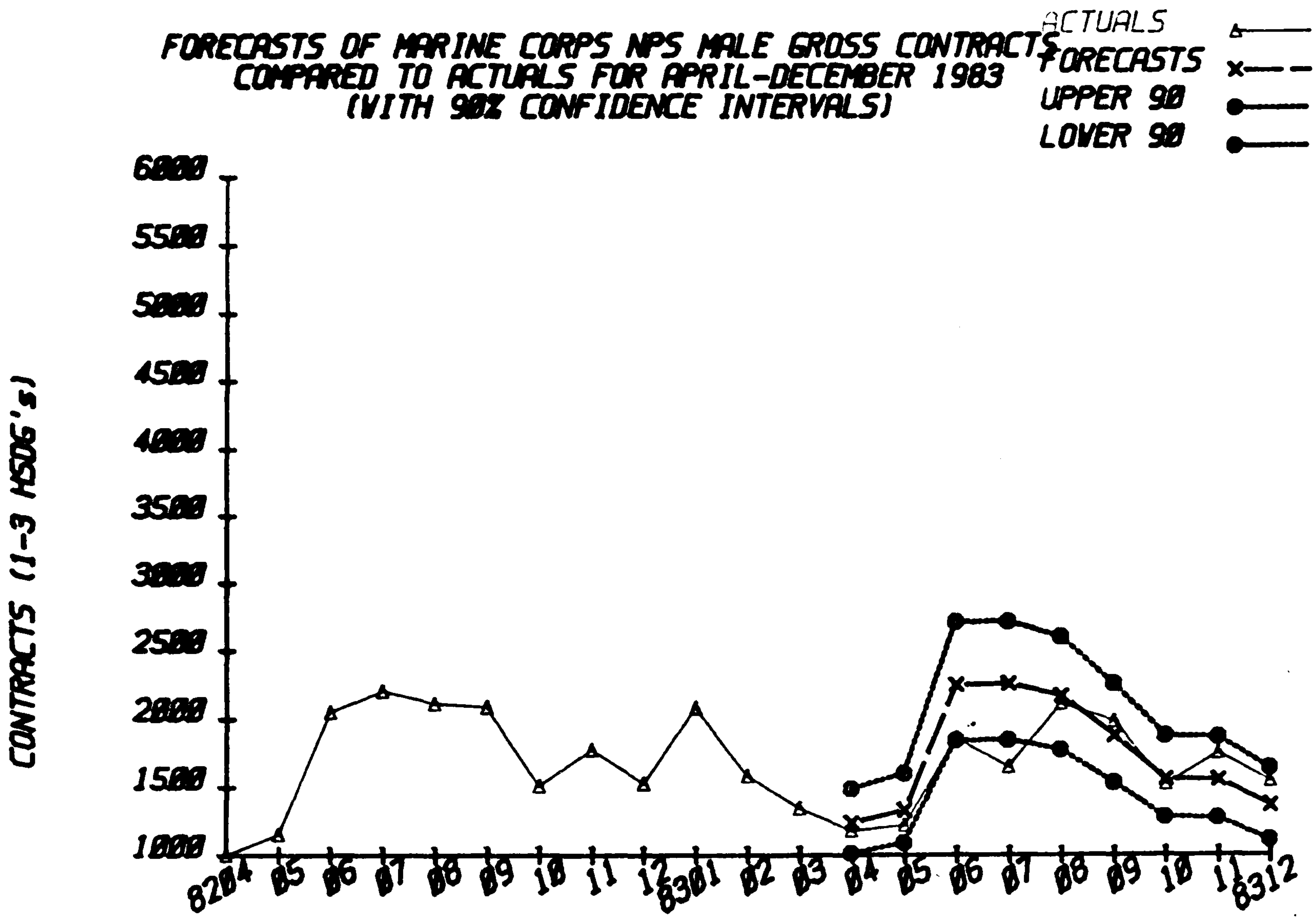


EXHIBIT 7.4

COMPARISON OF FORECASTS AND GOALS[a]

For High-Quality HSDG and HSSR Net Contracts

	ARMY (1-3A)			NAVY (1-3A)		
MONTH	FORECAST[a]	GOAL[b]	F/G	FORECAST	GOAL	F/G
8304	5538	5105	108%	3731	4266	87%
8305	5659	5284	107%	3503	2927	120%
8306	5801	4896	118%	4051	2927	138%
8307	5666	4887	116%	4335	3390	128%
8308	5346	5641	95%	4271	3664	117%
8309	4795	4378	110%	3598	4090	88%
8310	4135	4858	85%	3156	3915	81%
8311	4562	4362	105%	3041	3743	81%
8312	4590	4394	104%	2997	3783	79%

	AIR FORCE (1-3)			MARINE CORPS (1-3)		
MONTH	FORECAST	GOAL	F/G	FORECAST	GOAL	F/G
8304	3644	3599	101%	2229	2290	97%
8305	3548	3599	99%	2141	1546.	138%
8306	3804	3572	106%	3254	1981	164%
8307	4167	3594	116%	3466	2725	127%
8308	4304	3599	120%	3092	2397	129%
8309	3809	3926	97%	3054	2733	112%
8310	3001	3730	80%	2613	2350	111%
8311	2756	3763	73%	2597	2341	111%
8312	3119	4361	72%	2499	2389	105%

[a] Forecast of gross contracts adjusted for DEP attrition and failure of seniors to graduate from high school using 1982 data.

[b] Goal for total contracts times percentage of the total accession goal accounted for by high-quality enlistments.

EXHIBIT 7.5

DERIVATION OF NET FORECASTS AND NET GOALS

NET FORECASTS OF CONTRACTS

$$\text{GROSS}^{(\text{month } t)} \times \frac{\text{NET}}{\text{GROSS}}^{(\text{FY 1982})}$$

		ARMY	NAVY	AIR FORCE	MARINES
NET (FY 1982)	o				
GROSS	o	.941	.895	.917	.919

****

NET GOALS

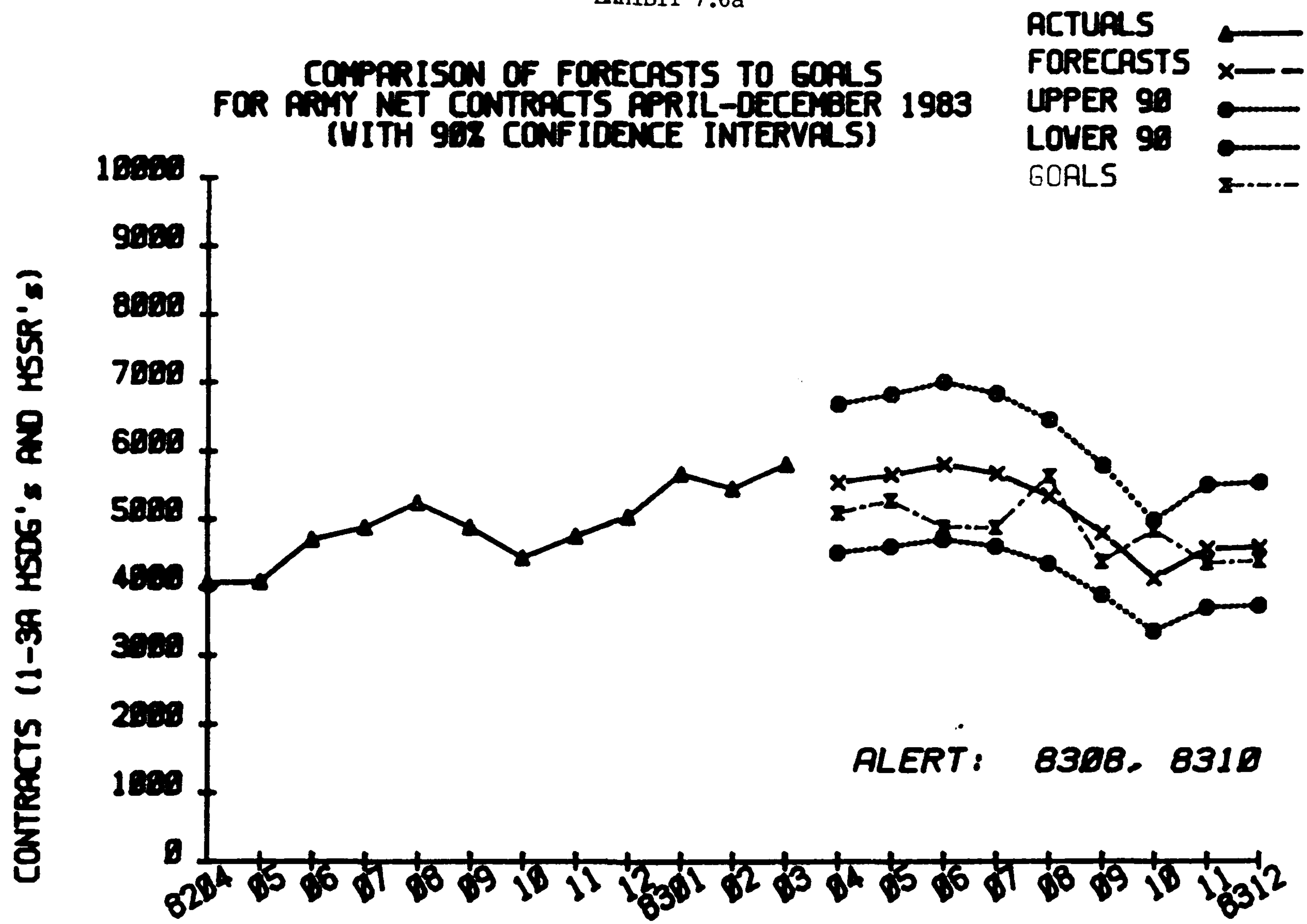
ARMY:
Net goals for NPS males 1-3A HSDG's and 1-3A HSSR's

Navy:
Net goal for total new contracts x percent male (84%) x percent 1-3A HSDG (67%)

Air Force:
Net goal for total new contracts x percent male (85%) x percent HSDG's (98%) x percent 1-3 (98%)

Marine Corps:
Net goal for regular males x percent 1-3 HSDG's (87%)

EXHIBIT 7.6a



COMPARISON OF FORECASTS TO GOALS
FOR ARMY NET CONTRACTS APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)
ACTUALS
FORECASTS
UPPER 90
LOWER 90
GOALS
CONTRACTS (1-3A HSDG's AND HSSR's)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
8204
05
06
07
08
09
10
11
12
8301
02
03
04
05
06
07
08
09
10
11
8312
ALERT: 8308, 8310

EXHIBIT 7.6b

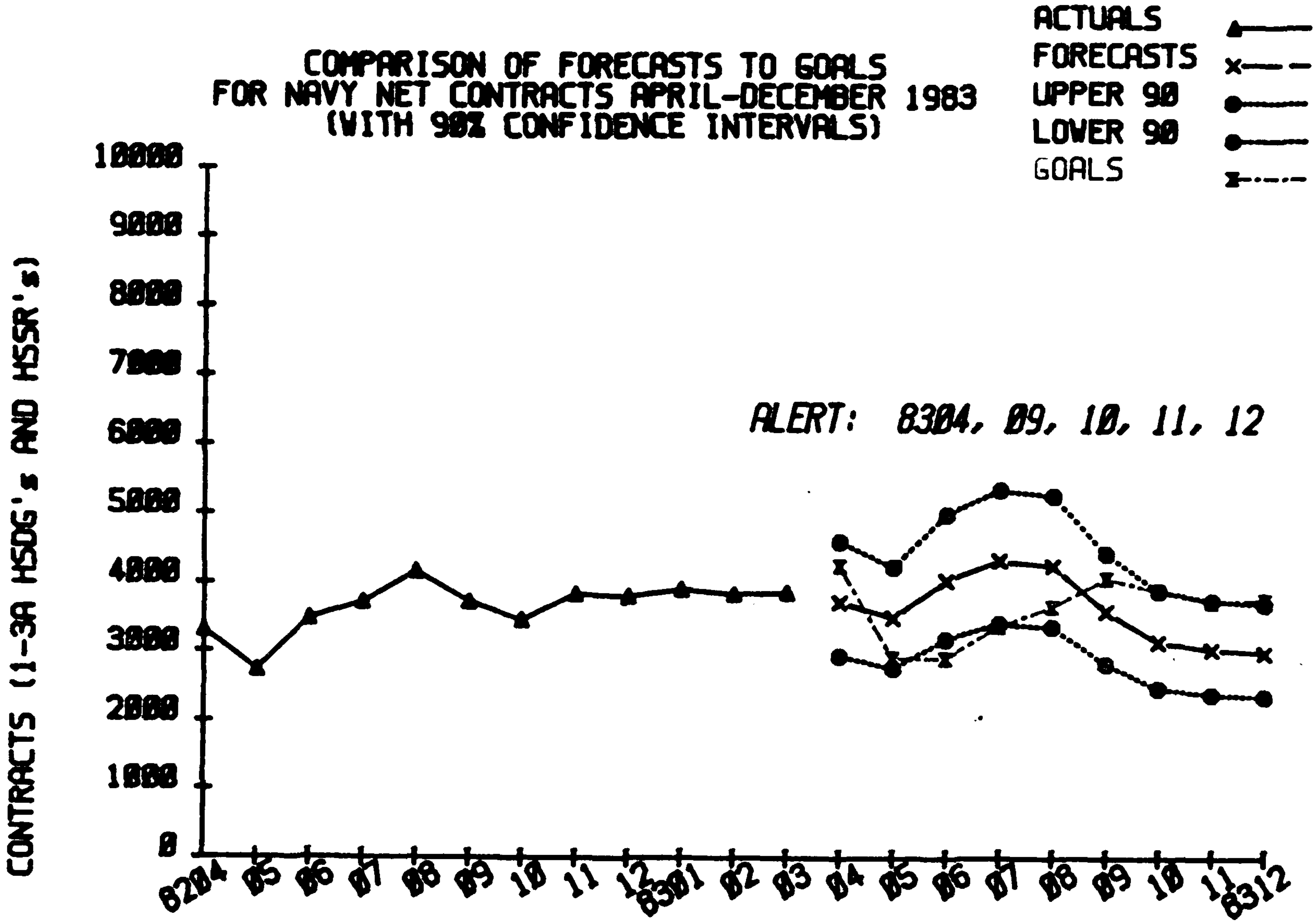

COMPARISON OF FORECASTS TO GOALS
FOR NAVY NET CONTRACTS APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)
ACTUALS
FORECASTS
UPPER 90
LOWER 90
GOALS
ALERT: 8304, 09, 10, 11, 12
CONTRACTS (1-3A HSDG's AND HSSR's)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
8204
05
06
07
08
09
10
11
12
8301
02
03
04
05
06
07
08
09
10
11
8312

EXHIBIT 7.6c

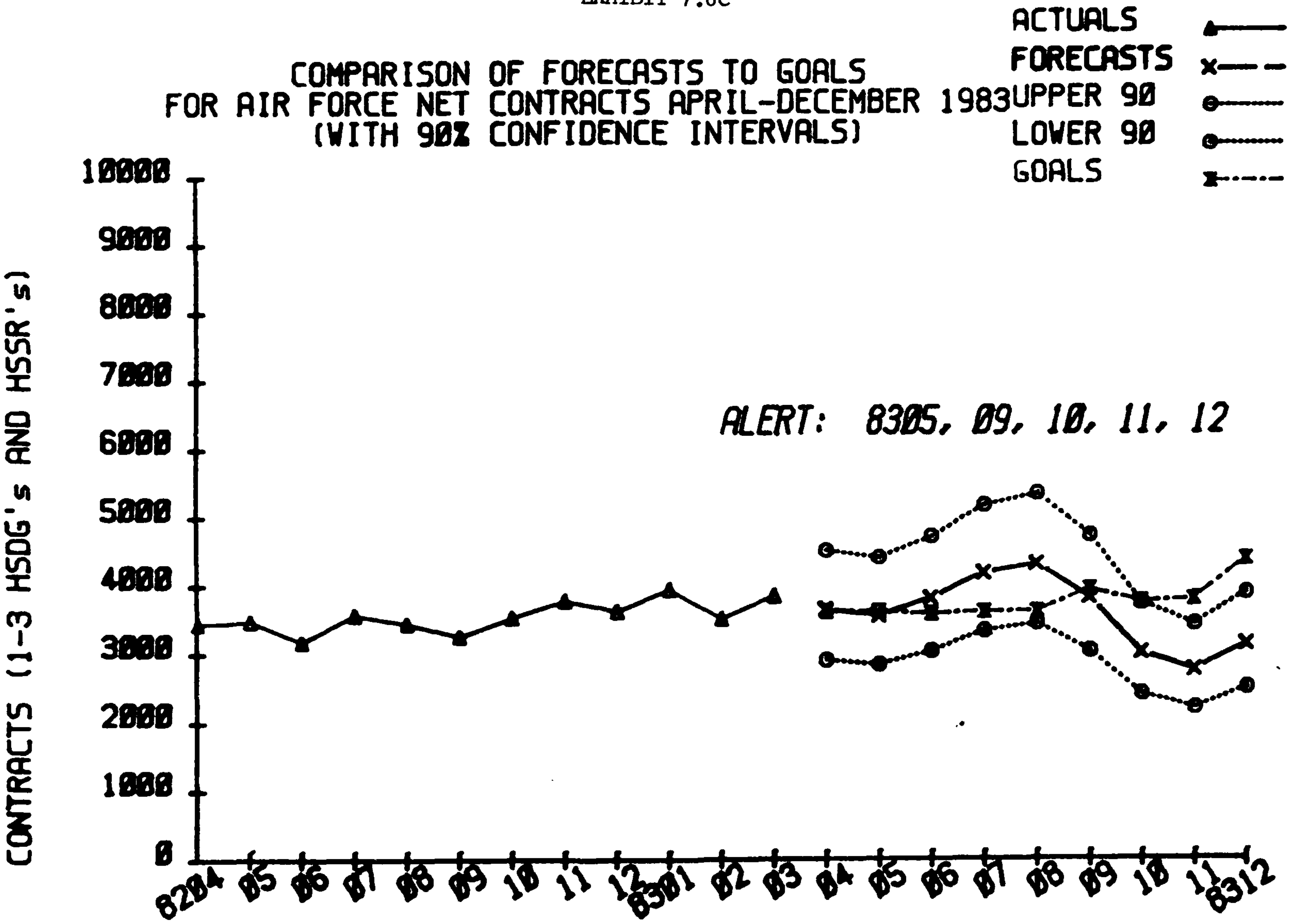
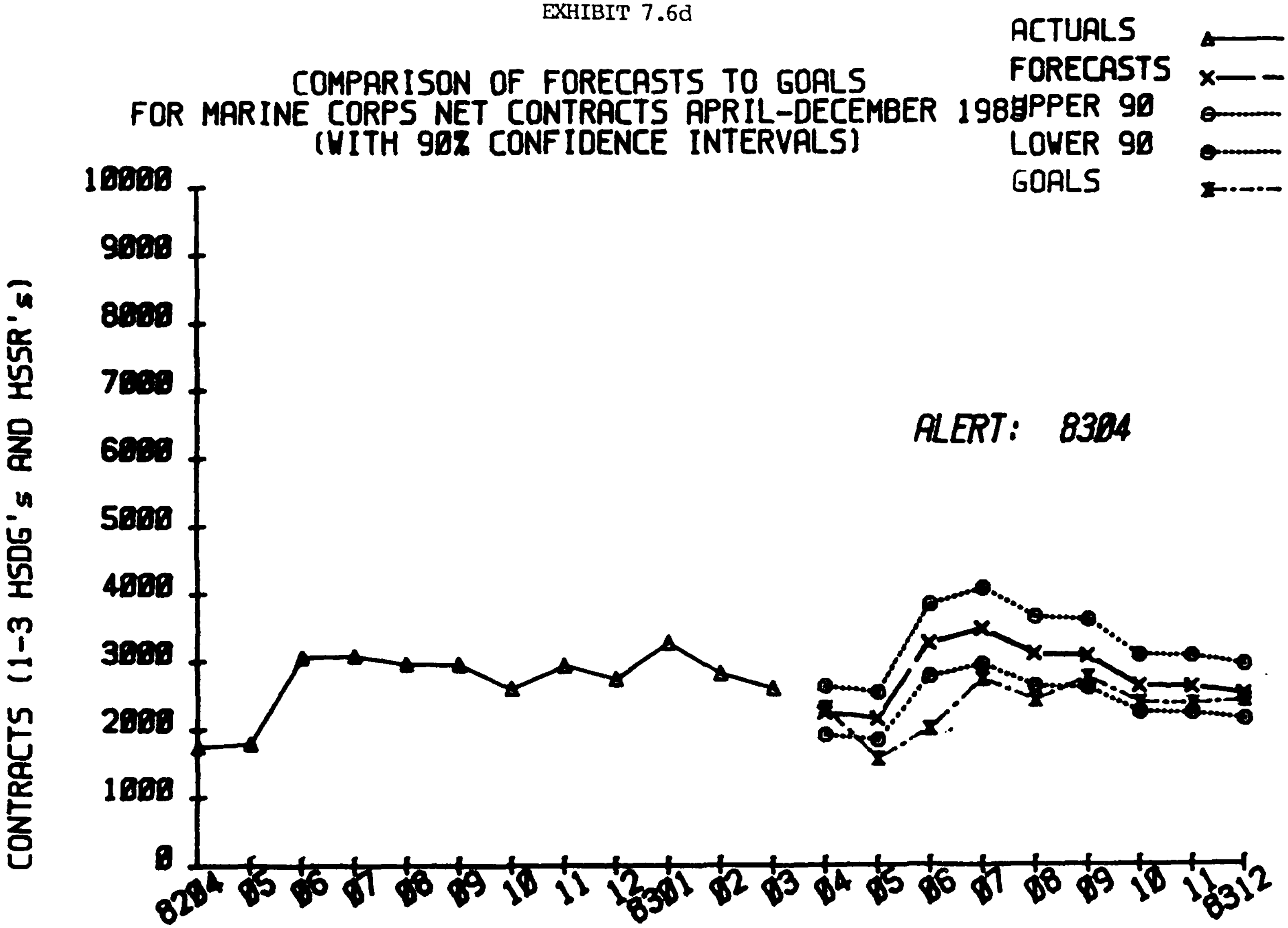

COMPARISON OF FORECASTS TO GOALS
FOR AIR FORCE NET CONTRACTS APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)
ACTUALS
FORECASTS
UPPER 90
LOWER 90
GOALS
ALERT: 8305, 09, 10, 11, 12
CONTRACTS (1-3 HSDG's AND HSSR's)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
8204
05
06
07
08
09
10
11
12
8301
02
03
04
05
06
07
08
09
10
11
8312

EXHIBIT 7.6d


COMPARISON OF FORECASTS TO GOALS
FOR MARINE CORPS NET CONTRACTS APRIL-DECEMBER 1983
(WITH 90% CONFIDENCE INTERVALS)
ACTUALS
FORECASTS
UPPER 90
LOWER 90
GOALS
ALERT: 8304
CONTRACTS (1-3 HSDG's AND HSSR's)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
8204
05
06
07
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8301
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8312

The forecasting test for April-December 1983 provides highly encouraging evidence that it is feasible to develop the forecasting models required for an EEWS. Indeed, it is unfortunate that the system was not available last April. In the fourth quarter of 1983 the Army warned that it was having recruiting difficulties. These difficulties would have been forecasted by the EEWS eight to nine months earlier through an analysis of recruiting for all Services.

C. <u>Can Human Assessment of an Alert Be Performed Expediently?</u>

For an assessment of the short and long-term recruiting situation to be timely, certain information and capabilities must be available for use when an alert is sounded. The EEWS forecasts and supporting data base would be available in the Monthly Report on the Status of the Recruiting Market, and would be presented in graphic or tabular forms of the users choosing. POM planning models such as ESP (OSD), RPAM (Air Force), and RA (Army) are available and could be maintained in updated condition. In addition, documentation of the methodologies used by EEWS and the POM planning models could be available for inclusion in an assessment report. With these resources available, we see no technical obstacles that would prevent the Human Assessment Group from carrying out a credible assessment quickly and efficiently.

The administrative/organizational components of the Human Assessment Group remain to be developed. The performance of a simulated human assessment would clarify many of the the management issues, and would enable us to determine how much time an actual assessment would require. We estimate that an assessment could be completed throughout the Services and OSD within four weeks. We expect to assist the Services and OSD in the development of a Human Assessment Group in Phase II. Confident that management procedures will be devised, we feel that expedient human assessment of EEWS alerts is feasible.

UNITED STATES ARMED SERVICES AND OFFICE
FOR THE SECRETARY OF DEFENSE

ENLISTMENT EARLY WARNING SYSTEM AND ACCESSION CRISIS PREVENTION PROCESS

VOLUME V DESCRIPTION OF AN AUTOMATED ENLISTMENT EARLY WARNING SYSTEM

JUNE 15, 1984

ECONOMIC RESEARCH LABORATORY INC.
Advanced Technology
SRA CORPORATION

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

Phase I. Therefore, this system description is primarily concerned with Stage II development of the Automated EEWS. As the Services become familiar with the system and new or different requirements are identified, the iterative design process will carry over naturally to Stages III and IV.

Initially the common data base will be centrally situated and maintained. The initial data base will be developed through information provided by the Services and OSD. It will then be updated on a monthly basis. Each Service and OSD will be responsible for the checking and validation of all data submitted. The data base manager will be responsible to verify correct copy of the data. The central data base will be designed to restrict access of certain areas of the data base to only those users authorized by the Services providing the restricted data.

The system will consist initially of the monitoring and forecasting algorithms (the EEWS model), a graphics model, and required DSS modules. In Stage III, additional statistical and analysis models can be added according to each Service's need. To make this system user-compatible, the system will be designed to provide:

- An easily accessible report data base for analysis, updates, and support;
- User-driven menus to access different models within the system;
- Appropriate security to insure the requisite confidentiality of each individual Service's data;
- A timely, accurate method of providing forecast data to validate and influence decisions regarding recruiting resources; and
- Standardized graphs, charts, and reporting formats that can be used across Services and OSD.

In summary, the DSS design for the automated EEWS will provide monitoring and forecasting capabilities for the Services. The system will provide report data for the Services. The Services will be able to use this data for their own reporting and analyses. The ability to

		STAGE I	STAGE II	STAGE III	STAGE IV
ANALYTICAL SUPPORT	ANALYSIS & "WHAT IF"	o INITIAL MONITORING ALGORITHMS o INITIAL FORECASTING ALGORITHMS	o MONITORING ALGORITHMS o FORECASTING ALGORITHMS	o ADDITIONAL ANALYSIS MODELS* o ENHANCED ANALYTICAL CAPABILITIES**	
USER SUPPORT	GRAPHICS	o STANDARD PACKAGE - BAR CHARTS - PIE CHARTS - GRAPHS	o STANDARD PACKAGE - BAR CHARTS - PIE CHARTS - GRAPHS	o ENHANCED GRAPHICS CAPABILITIES**	
	USER INTERFACE		o DIALOG INTERFACE COMPONENT o REPORT GENERATOR o USER DRIVEN MENU	o ENHANCED USER USER INPUT/ INTERFACE**	o AUTOMATED DATA BASE UPDATE o EXTERNAL DATA ACCESS

* AS DESIRED BY INDIVIDUAL USERS
** BASED ON USER INPUT FROM STAGE II

FIGURE 2-1. DEVELOPMENT OF THE AUTOMATED EEWS

interim system while the more appropriate system is being developed. In the long run, either of the other options would more appropriately meet all identified objectives defined in Paragraphs A and B of this chapter. For these reasons, the first option is not considered practical for long term use in the Automated EEWS. The latter two options are similar, differing primarily in the location of processing and the location and updating of the data base. Both options can be supported by the same basic architectural design with only minor modifications between the two.

It is envisioned that in Phase II of the study the system be developed in four stages (see Figure 2-1). Stage I will be the installation of an interim batch system and the development of the detailed design of the basic Automated EEWS DSS. This will allow the Services and OSD to begin receiving data forecasts as soon as possible. The development of the basic model for operation at a centrally located data processing site with time sharing access by each Service and OSD will occur in Stage II. This initial model will contain the basic modules of the system (discussed later in Chapter IV), required interfaces, and the common data base. During this stage, the Services and OSD will be able to familiarize themselves with the system and its uses. Feedback from the users during Stages I and II will be incorporated in any design changes or enhancements for the Stage III system. Stage III of the system development will involve tailoring the system for each user by adding additional modules providing desired capabilities and the transfer of the system to individual user data processing sites. The Stage III system will be formatted for access through the same Dialog Component used in the Stage II system. This will promote ease of training and use by the users. Stage IV of the system development will provide the capability to update automatically each user's data base and the common data base with communication between the two to insure accuracy of data.

The Stage I system will be a fairly unsophisticated batch system producing standard reports and will be designed based on the experimental model developed to support the research process of

- OSD and Services provide input to central data base; and

- Standard reports for all Services and OSD.

o <u>Centrally-located</u> <u>Data</u> <u>Processing</u> <u>Center</u>. Time Sharing Environment:

- OSD and Services provide input to central data base;

- User interaction with system via telecommunications;

- Standard reporting data provided for all Services and OSD; and

- Capability to individually tailor reports provided through graphic and reporting modules of the system.

o <u>Individual</u> <u>User</u> <u>Data</u> <u>Processing</u> <u>Center</u>. Time Sharing Environment:

- Supported by Central Data Manager at central site;

- Central Data Manager updated by OSD and Services;

- Individual user data base containing Service-unique data;

- Periodic validation of user data base by Central Data Manager;

- Additional individual analytical capabilities as desired by the user; and

- Capability to individually tailor reports provided through graphic and reporting modules of the system.

The first option, a centrally located system using a batch environment, does not provide all capabilities identified in Paragraph A of this chapter as desirable for the system. When used in conjunction with the Crisis Prevention Plan, it could meet the objective of the EEWS in supporting reduction of the budget lag if timely information were provided. It is questionable, however, that this option would consistently provide data in a timely manner because of possible data update, system processing, and report transmittal delays. Also, this option does not meet all objectives for the Automated EEWS, particularly in the areas of usefulness and adaptability. This option could be used to validate the monitoring and forecasting algorithms of the EEWS, and could easily be installed as a

The Navy uses recruiting results of the other Services as a monitor to determine how well they are doing. The Navy also feels that prior Service enlistments is a leading indicator. In addition, the Navy considers the number of high-quality examinees who choose not to enlist as an important indicator.

The Marine Corps monitors the number of contracts, appointments, and interviews made by recruiters. DEP stock and DEP loss are monitored as well.

The Army is presently evaluating several policy analysis models in the hope of using them in forecasting. Also, leading economic indicators, youth attitudes, unemployment, and applicants are monitored.

As mentioned previously, there is little coordination among the Services in this effort and consequently, no unified front for obtaining funds from appropriate sources for use in the recruiting process. Each Service develops the information that it feels is necessary to obtain funding for recruiting resources and presents this information to the appropriate budgetary committees. Analysis of data in one Service might be inconsistent with that of another, and the resulting requests can be in direct conflict. Such a situation can be heightened by interservice competition for enlistments and resources.

D. Proposed Methods and Procedures

Early in the study, three possible options were identified for processing the Automated EEWS. Each option offered slightly different capabilities and different operating environments. Descriptions of these three options are provided below:

- o <u>Centrally-located Data Processing Center</u>. Batch Processing Environment:

  - No user input or specification for system processing;

- **Usefulness:** The system must have the ability to access significant amounts of data (both external and internal), to easily maintain and update internal data records, to process data through a variety of models and output devices, and to be accessible by multiple users.

- **Adaptability:** The system must be designed so that it can be changed, modified, added to, and deleted from with minimum cost and effort and without disruption to the users.

- **Affordability:** In any system, development cost is an important consideration; however, it is most important to minimize the total life cycle cost to insure that the system remains cost-effective.

The DSS system description for the Automated EEWS is designed to meet these objectives and to provide and support information for the EEWS process. The EEWS will monitor and forecast enlistments as well as supply and demand factors in order to provide decision support for the Services and OSD in preventing enlistment shortfalls.

C. Existing Methods and Procedures

There currently is no common automated system available to the Services that meets the capabilities of the EEWS. In addition, although there is cooperation, there is little coordination among the Services in the forecasting of enlistments and responding to enlistment downturns. Each Service relies on its own procedures for justifying requests for additional recruiting resources. While there are some similarities in the methods used to predict changes in the market, there is no commonly accepted, approved method upon which to justify short-run needs to OSD and Congress. The EEWS is intended to provide this method.

The Air Force currently monitors 20 to 25 variables that are updated on a monthly basis. Among the different variables monitored are Army and Air Force contracts, the number of males tested by the Army and Air Force, the size of the Delayed Entry Pool (DEP), Air Force jobs available, national indicators of labor market conditions, and aggregate market activity.

- The design should allow special modules, desired by a Service, to be incorporated into the system architecture;

- The centralized data base should allow for periodic update of the individual Services' data bases to ensure their validity; and.

- The system should be developed in an iterative fashion so that it can be added to and improved on over time.

The preliminary design provided in this document is intended to provide these desired capabilities.

B. Objectives

The main objective of the EEWS is to provide timely and accurate data on the current and near-term indicators that are relevant to the Services' recruiting efforts. Another important objective is to reduce the budgeting lags that have previously been encountered by using automated monitoring and forecasting algorithms contained in the EEWS and the use of a Crisis Prevention Plan. These two objectives are the most critical measures by which the success of the EEWS can be determined. The accomplishment of these objectives is the topic of Volumes IV and VI of the project report.

There are additional objectives for the automated system and its relation to the EEWS. These are desirable objectives for nearly all automated systems and serve as basic guidelines in the development process. These objectives include: usability; usefulness; adaptability; and affordability. A description of these terms and their applications is listed below:

- **Usability:** The system must be easy to learn and understand, provide for natural and simple operation and interaction, provide the user various means of applying system capabilities, and respond to user input in a friendly and timely fashion.

This volume of the project report addresses the third question by providing a description of the Automated EEWS. The design provided in this document demonstrates the feasibility of an automated system and supplies a baseline for system design and development. Although other options are available, the system has been structured as a Decision Support System (DSS) because of the versatility and flexibility of this structure. Early in this study, a wide variety of requirements and desired capabilities were identified among the potential users of the Automated EEWS. The DSS offers the best and most adaptable structure to satisfy these needs. In addition, the DSS will provide the Services the best value for their money. In particular it will:

- Provide a system with capabilities that can be easily maintained at a state-of-the-art level;
- Minimize user training requirements, (even with frequent turn-over in user personnel);
- Reduce total system life cycle costs;
- Enhance analytical capabilities currently available; and
- Provide a vehicle to consolidate and integrate all systems associated with the accession market program.

It might be noted that the development of a system description is the point in a study where the results from previous work culminate into a set of guidelines for use in designing an operational system. It is for this point that this document has been prepared.

To aid the reader in evaluating and understanding the contents of the system description, certain capabilities, identified by the Services and contractors as required of this system, are noted below:

- The system should be designed as a DSS that supplies both monitoring and forecasting algorithms, along with graphics and report-generating capabilities which the Services can use in conjunction with the data and forecasting algorithms to meet individual Service reporting requirements;
- The Services should have the capability to maintain an independent copy of the data base and to both update and access a common data base at a jointly selected site;

CHAPTER II

SYSTEM SUMMARY

A. Background

The study effort resulting in this system description is the first step of a project to develop an EEWS that will support the recruiting efforts of the four military Services. It is known that fluctuations in the recruiting market effect the Services' ability to meet accession goals or requirements. The need for an EEWS was generated by the inability of the Services to project these unexpected fluctuations in the recruiting market with sufficient lead-time to allow them to obtain additional resources (or to reallocate existing resources) to meet the fluctuation. Varying economic conditions directly impact upon the Services ability to attract volunteers from the enlistment-age population. The need has been recognized to develop the ability to monitor and forecast these conditions and their impact on the expected enlistment market in order to appropriately assign recruiting resources when and where they will provide the greatest benefits.

To determine the feasibility of an EEWS, three questions provided the framework for the assessment:

- Can a validated procedure be developed that will provide accurate near-term forecasts of enlistments?
- Can a Crisis Prevention Plan (CPP) be developed that would significantly reduce budgeting and implementation lags?
- Can a computer-assisted system be developed that will provide the Services and OSD monthly status reports in a timely fashion?

user might perform when thinking about a decision or problem.

- OSD: Office of the Secretary of Defense.

- **Representation**: A display that portrays various elements or information concerning a decision or problem.

The previously listed terms and abbreviations are used throughout the report to ensure consistency of thought and communication.

support process. Thus, it is necessary that specific terms be identified or defined to describe the basic functions and the components of Decision Support Systems. These terms, as well as applicable data processing terms and others, are defined below to provide a basis of common understanding between the author and readers of this document. In addition, the following list contains abbreviations used frequently throughout the text of this document.

- Architecture: The documented structure or design of a system. In this case the organizational structure of the software involved with the DSS.

- Control: The means by which a user exercises system capabilities.

- Data Base Component: A software module containing a set of data bases, (including response logic and temporary or intermediate results), a data base management system, and an extraction capability for accessing information contained in sources external to the system.

- DBMS: Data Base Management System.

- Dialog: Interaction between the user and the system.

- Dialog Component: A software module that drives input and controls system response for one or more dialogs.

- DSS: Decision Support System, in this document DSS refers to the specific system being described to support the Early Warning System.

- EEWS: Enlistment Early Warning System.

- EWS: Early Warning System.

- Interface Component: A set of software modules that allow communications or access among other components not designed to interact. This component normally includes an interface control module.

- MBMS: Model Base Management System.

- Modeling Component: A software module, under the control of a Dialog Component, that is used to transform information from one form to another.

- Operation: A system capability that the user can invoke and which corresponds to an intellectual operation that the

CHAPTER I

GENERAL

A. Purpose of the System Description

The purpose of this document is to provide a system description for the Automated Enlistment Early Warning System (EEWS). The study from which this design resulted was jointly sponsored by the four Services and The Office of the Secretary of Defense (OSD) as a preliminary step in the development of an Early Warning System (EWS) to provide an alert of potential problems in the recruiting market. In addition the EEWS will aid in tracking and projecting trends and indicators of the market. This system description does not describe the methodologies of the EEWS, but rather focuses on describing the automated support capabilities needed to provide EEWS information to the Services.

The purpose of a system description document is to describe an automated system in sufficient detail so as to allow effective managerial review, facilitate efficient system design, and define specific criteria against which the system design can be measured. The basic elements of a system description document include: a discussion of the purpose and objectives of the system; an identification of the functional requirements that the system is intended to support; and a description of the characteristics upon which the system design is to be based. These elements are provided in Chapters II, III, and IV of this document. In addition, Chapter V outlines potential problem areas that have been identified related to the system development process.

B. Terms and Abbreviations

The Automated EEWS is designed as a state-of-the-art Decision Support System (DSS). Terminology typically associated with data processing will not always support discussions involving the decision

LIST OF FIGURES

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monitor and forecast accurately will provide the lead time necessary for the Services to plan ahead and prevent budgeting and resource lags when difficulty is predicted in the recruiting market.

E. Assumptions and Constraints

The system description has been developed based on certain assumptions and constraints. Some of these have been previously mentioned but are listed here for clarity's sake. Assumptions made during the system description are that the Automated EEWS will:

- o Have a centrally located data base;
- o Provide for monthly update of the data base;
- o Allow the users on-line access to the system;
- o Provide access to report data as generated; and
- o Provide for confidentiality of information.

Various constraints must be kept in mind when developing the final system design for the Automated EEWS. These constraints include:

- o The availability and applicability of off-the-shelf software;
- o The computing environment of the Services;
- o Monetary constraints (both on an individual Service basis and an overall basis); and
- o User familiarization of system capabilities and interfaces.

These assumptions and constraints have been agreed upon by both the expected users and the contractors.

CHAPTER III

FUNCTIONAL CHARACTERISTICS

A. Automated EEWS Functions

The DSS architecture suggested for the Automated EEWS is structured to support the decision making process associated with an EWS for the recruiting market. In particular, the system will provide monitoring and forecasting capabilities to the Services and OSD upon which to maintain watch over the recruiting market. In addition, reporting and graphics capabilities will be provided to support decisions concerning the recruiting resource requirements. To accomplish these tasks, the Automated EEWS must provide decision support by:

- Supplying to the Services timely and accurate data that is relevant to the recruiting market;
- Maintaining a current and up-to-date data base that accurately reflects recruit market conditions; and
- Providing clear and concise reporting capabilities for the Services to use in analysis and presentation of data.

The design of the Automated EEWS is top down and of modular structure in order to provide maximum system flexibility for dealing with future modifications. Modifications may be required due to changes in either technology or operational needs. We have recommended an iterative approach to this design that will provide the ability to add to and update the system. We feel that this approach will allow: the capabilities of the system to remain state-of-the-art; feedback from the users to be incorporated into the system; the users to grow with the system; and the Services to maintain closer control of system development. The DSS design described in this report is aimed specifically at providing those capabilities suggested for the Automated EEWS.

1. System Overview

A DSS supports the decision making process by conducting a dialog with the user, leading the user through the process, and providing the user with relevant information. While the system will not make a decision for the user, it does provide much more support than a typical management information system. The Automated EEWS will provide data produced by the monitoring and forecasting algorithms of the system for the user's inspection and analysis. The dialog provided by the system will be conducted through user-supplied input and resulting displays or representations (based on user input) returned by the system. To provide the required support, the initial design of the Automated EEWS is comprised of three system components. These three system components include:

- Dialog Component: The purpose of the Dialog component is to maintain a dialog with the user by interpreting user inputs, selecting and constructing appropriate output displays, and developing control action commands to activate the desired capability.

- Modeling Component: This component provides a set of software programs that are designed to perform the selected capability.

- Data Base Component: The Data Base Component is the repository for all information necessary to system operation. In addition, it will serve to integrate the three system components.

Subsequent Paragraphs A.2 through A.4 provide descriptions of the functions that are performed by the Dialog Component, the Modeling Component, and the Data Base Component, respectively.

2. Dialog Component Functions

The Dialog Component is a set of modules that maintain user-system interaction and develop necessary commands, based on user input, to exercise system capabilities. The basic functions

of this module are to control access to the system capabilities and to provide the user the means of selecting the capability to be exercised. Specifically, the Dialog Component must:

- Identify the user and determine which system capabilities are available to the user;
- Display for the user those capabilities that are available and allow the user to select the specific capability to be performed;
- Based on user-selected capability, determine if additional instructions are required before the capability can be activated and, if so, provide these instructions to the user;
- Translate internal information into descriptions of output representations;
- Determine the output device functions that are required to create the representations;
- Create instructions for specific output devices (hardware items) associated with the system;
- Provide communications between input/output devices and system logic;
- Translate specific device input into independent control action information;
- Develop internal control action commands based on input control action information;
- Communicate commands and information to other system components; and
- Temporarily store input/output information.

In general, these functions can be divided into two basic groups, each of which allows the Dialog Component to perform a necessary operation. The first group is composed of those functions needed to develop and display output representations used by a DSS; the second of those functions used to specify control mechanisms within a DSS.

3. Modeling Component Functions

The Modeling Component is a set of modules that supply the procedural and analytical capabilities provided by the system. These modules combine to:

- o Interpret control action commands into specific program processing instructions;
- o Identify and extract necessary processing information from system files;
- o Control model (and sequence of model) processing and modeling options exercised;
- o Provide for temporary storage of intermediate processing results;
- o Control the transfer of information between programs; and
- o Provide for storage of final results in system output files.

These functions are all concerned with the management of model processing. In addition, specific programs within the Model Base Module of this component must provide the functions and operations needed to perform required capabilities.

4. Data Base Component Functions

The Database Component provides both the management function required to support the system data base and the set of system files needed to support the DSS processing. Specific management functions that must be performed include:

- o Create new system files, both permanent and temporary;
- o Maintain, edit, and update system files;
- o Validate system files during file creation, maintenance, and updating processes;

- Protect files from unauthorized access and from unauthorized or accidental deletion; and

- Provide procedures for access and retrieval of information contained in system files.

Paragraph G contains further discussion of the system files and their use in supporting the operation of the DSS.

B. Automated EEWS Performance Requirements

Regardless of the capabilities provided by the Automated EEWS, the system will not be valuable to the Services unless it is easy to use and possess other characteristics conducive to operation at an individual Service level. To ensure that the system meets its intended needs, the following requirements must be considered in the design of the Automated EEWS. Specifically it must:

- Be designed to allow implementation of the system for the Services within a reasonable lead time and at a justifiable cost, that provides valuable support to the Services to use in the decision-making process;

- Accommodate the use of existing models, commercial software, and other models specifically designed for the system;

- Provide for friendly user-system interaction, the capability to operate in an office environment, and provide adequate user response time;

- Be sufficiently adaptable as to allow use by all four Services;

- Provide a logical vehicle for supporting both iterative capabilities development and evolutionary software structure approaches incorporating user feedback; and

- Allow growth potential in terms of either new or unforeseen system hardware and support requirements.

These requirements can be simply summed up by stating that the system must be usable, useful, adaptable, and affordable.

C. Inputs/Outputs

Inputs to the Automated EEWS operation will come from the user and from information selected from existing system data files based on dialog between the user and the system. In general, these inputs are control action specifications and parameter values provided by the user, and permanently stored processing data/information contained in the Data Base Component. The data/information contained in system files will require the input of updated values during file maintenance processes. These files will contain data for the variables listed in Exhibit 7.1, pages 139-41 of Volume IV of the project report. Control action input requirements can not be specified until programs have been designed for the Automated EEWS.

System outputs will be of two varieties. First, the system will provide *displays or representations to the user during user-system* interaction. Specific displays will be based on response logic and user input, and will be identified in final design of the system Dialog Component. The second type of system output will be hard copy reports. The contents and the format for these reports will also be identified in final system design. At this time, it is intended that reports will be provided in standard output formats; however, it is also intended that a variety of standard formats will be available for the same information to allow the user flexibility in reviewing output results. An outline of an output report and samples of graphics that could be available from the Automated EEWS can be found in Appendix A of this Volume.

CHAPTER IV

DESIGN CHARACTERISTICS

A. DSS Description

For the purpose of this description, we define the Automated EEWS as a set of programs for modeling and forecasting relevant data to aid the Services in evaluating the recruiting market. Although the system will be composed of both hardware and software, this system description will only discuss software since a processing site has not been selected and hardware will likely vary from site to site. The software structure upon which this system is based has been termed (by Sprague and Carlson, Building Effective Decision Support Systems, Prentice Hall, 1982) as the Tower architecture. A description of the Tower architecture is contained in Paragraph A.2. Off-the-shelf software selected for use in the initial Automated EEWS will be incorporated into the system's architectural structure. This might require the development of a set of interface components, including an Interface Control Module, depending upon the software package selected. Components designed and developed specifically for the Automated EEWS will be structured to fit directly into the Tower architecture.

1. Software Architectural Structure

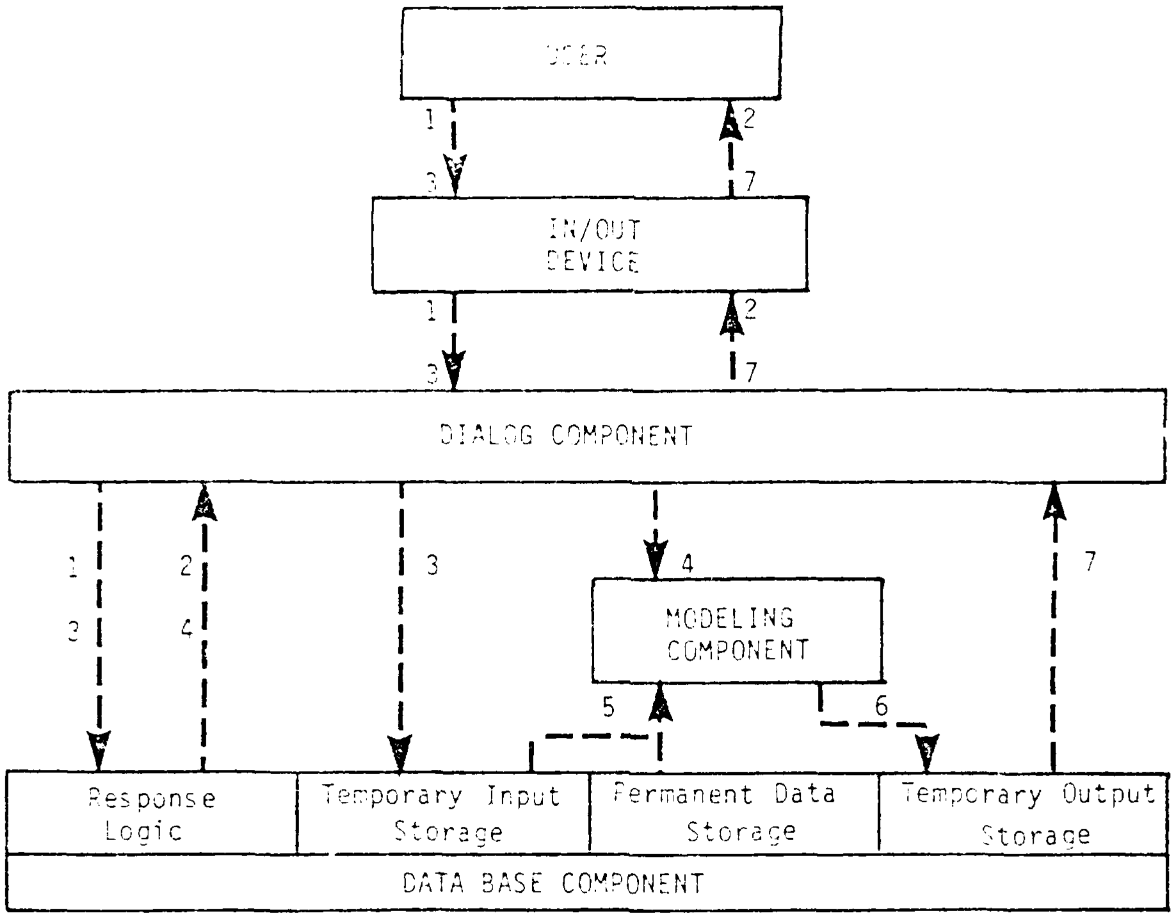
A typical DSS structure is comprised of four components: Dialog Component, Modeling Component, Data Base Component, and Interface Component. While nearly all DSS structures incorporate the first three components, the Interface Component is only required to provide needed interfaces when such interfaces are not designed into the other system components. The primary purpose of the system's architectural structure is to provide a mechanism for integrating the components of the DSS. Effective integration of the components is important because most problems

in developing decision support systems are caused by technical difficulties resulting from ineffective component integration.

An effective and highly-used concept of integrating the DSS components is the use of the Data Base Component to integrate itself along with the Dialog and Modeling Components. This concept is attractive because from both the user's and builder's point of view, it provides a logical location of integration. For the user, the integration occurs because the Data Base Component provides memories used in the decision making process. For the builder, integration using this component simplifies design, implementation, and maintenance of the system. The use of the Database as the integrating component offers several distinct advantages:

- o The data base can be used to share information among the various Modeling Components within the structure;
- o Where multiple Dialog Components are used in the structure, the data base can be used to share information between the various Dialog Components, and between the Dialog and the Modeling Components;
- o The data base can be used to store parameters for the Modeling Component. This separation of models and parameters makes modification to models easier;
- o The data base can be used to store response logic and output formats for the Dialog Component; and
- o All data base management functions can be located in the Data Base Component and do not need replication in the Modeling or Dialog Components.

In general, using the data base as the integrating component simplifies the sharing of information among the components of the system. The concept for using the data base as the integrating component is shown graphically in Figure 4-1. This figure portrays the concept in its simplest form and is not intended to restrict the concept to this level of application.



1 User requests execution of "Model A."

2 System responds to User by requesting certain modeling parameters.

3 User inputs specified modeling parameters which are stored in temporary memory.

4 Based on input of modeling parameters, logic indicates activation of Model.

5 Modeling Component accesses system memory and extracts necessary information for execution.

6 Results of model execution are stored in temporary memory.

7 Results of model execution are displayed to the user.

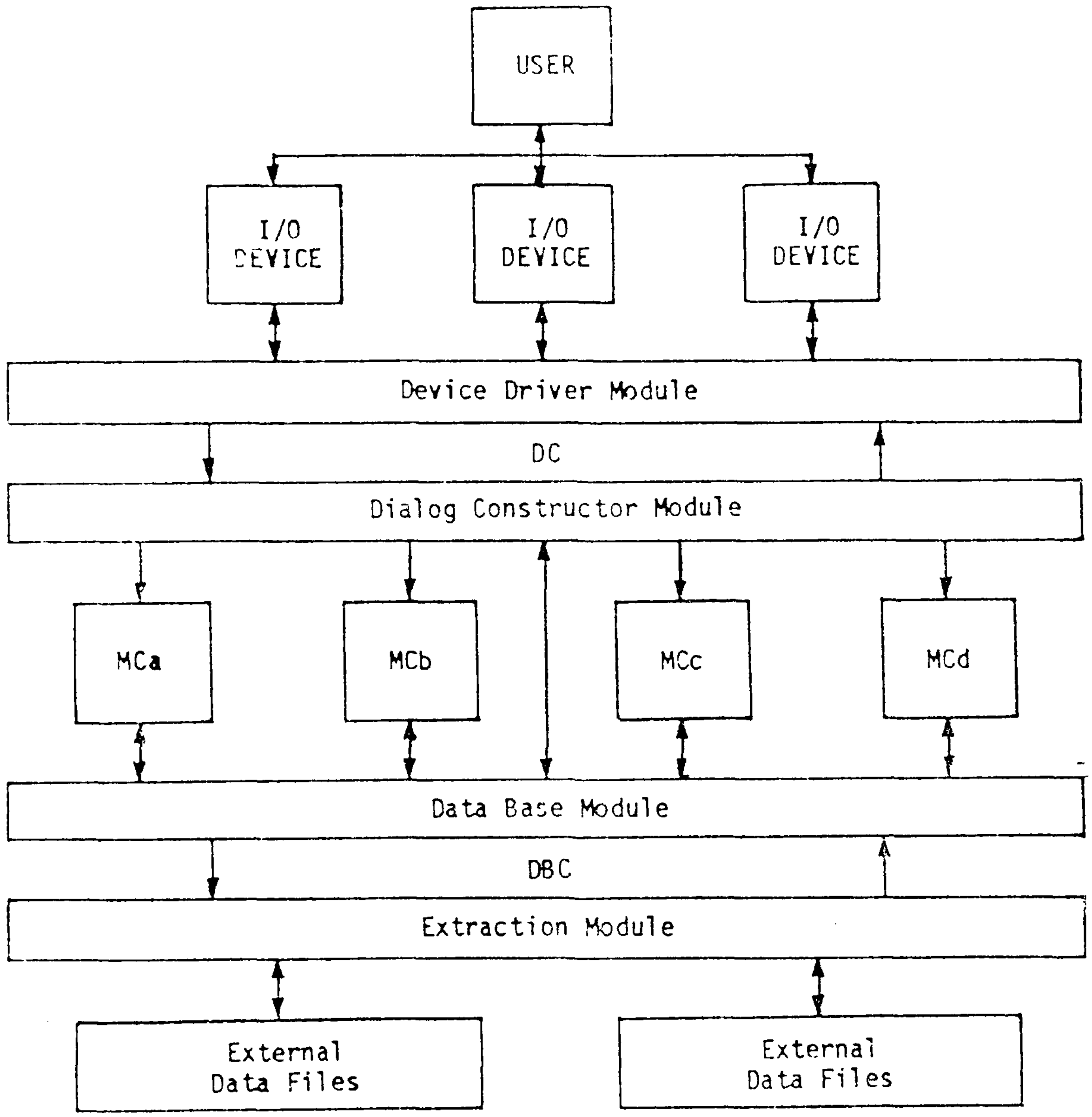
FIGURE 4-1. DATA BASE COMPONENT INTEGRATION

2. Tower Software Architecture

The Tower Architecture being used in the Automated EEWS description offers several features not available with the other classical software architectures. An example of the Tower Architecture can be seen in Figure 4-2. There are several advantages associated with the Tower structure and its use.

The most prominent feature of the Tower architecture is the use of a single Dialog and single Data Base Component. Also, unlike other classical architectures, the Dialog Component is divided into three modules: the Dialog Constructor Module; the Dialog Access Module; and the Device Driver Module. Because the Dialog Constructor Module is separated from the Device Driver Module, new dialog capabilities can be added in a relatively simple manner. This means that new modeling components can be added and the required associated dialog can be incorporated into the Dialog Constructor Module. This capability adds a great deal of adaptability to the structure. The separate Dialog Constructor Module also enhances the communications between Dialog and Modeling Components because it is capable of providing multiple dialogs between the user and the Modeling Component. This feature is not available in other architectures and greatly increases the usability and usefulness of the system. The Device Driver Module also adds a feature unique to the Tower Architecture. Each user can have multiple input-output devices and new devices can be easily added to the system because device-specific code is isolated in the Device Driver Module. A primary requirement of the Tower structure is that all the components in the system must perform in the same operating system. This should not prove to be any hindrance in the development of our system description. Primary advantages of the architecture are that it provides:

- Adaptability;
- Low operating costs;



DC = Dialog Component
MCi = Modeling Component i
DBC = Data Base Component

FIGURE 4-2. [illegible] ARCHITECTURE

- o Ability to interface with external data sources;
- o Ease in comprehension and execution;
- o Reliability; and
- o Multiple devices for a single user.

The primary disadvantage of the Tower Architecture is that it has somewhat higher development costs than most other typical structures. However, in general, it has a lower life cycle cost because it is less expensive to operate and maintain.

B. Automated EEWS Logic Flow

A computer terminal will serve as the primary input/output device for user interaction with the system. The user will also have available other output devices (such as a printer and a graphics output device) upon which output displays or reports can be produced when desired. User access to the system is provided through the terminal.

A standard "log on" screen will be displayed whenever the Automated EEWS is called for initiation. The user will log onto the system by entering the user ID code in the appropriate place on the screen. This code will then be interpreted by the Dialog component to identify which system capabilities (or system components) can be made available to the user. The user would then be provided a menu of capabilities from which to select. Once the user has entered a selection, the Dialog Component will provide the user a display of special instructions, if any, needed to initiate execution of the selected capability. When the selected capability has been initiated, control of user-system interface is continued by the Dialog Component.

When the user selects a capability provided by one of the packages in the Automated EEWS, the Dialog Component will provide information by way of terminal displays that will guide the user through the selection of those control actions necessary to activate and utilize the desired capability. To accomplish this, the Dialog

Component will provide the use of a set of tailored display representations with which the user will interact to select and enter the next control action. The Dialog Component will interpret the control action and, based on this interpretation, access the appropriate response logic contained in the Data Base Component. The response logic will instruct the Dialog Component as to the next step or set of steps to be accomplished. During interaction with the user, the Dialog Component will require the user to input any specifications necessary to perform the selected process or to display intermediate and final results. For example, the user may be prompted to enter certain modeling parameters and asked if the results of the modeling process should be displayed in a pie or bar chart. In the case of such user input, the response logic would instruct that information relative to performing the selected process is to be stored in the Data Base Component for access by the Modeling Component. Information concerning display representations is to be retained in the Dialog Component for use at the appropriate time.

When the response logic indicates that the next step in the process is the use of a model, the Modeling Component is activated and provides appropriate information concerning user instructions and disposition of resulting output information. The Modeling Component will access the Data Base Component and extract modeling specifications. Based on the modeling options that have been selected, the Modeling Component will access the appropriate data files and extract all data necessary to perform the required processes. During processing the Modeling Component will use temporary storage in the Data Base Component to retain any required intermediate data. Once the Modeling Component has completed all required processing, final resulting output data will be stored in the Data Base Component for access by the Dialog Component.

The Dialog Component will provide a display of the output data based on instructions previously provided by the user. These displays can be provided on any of the output devices as directed by the user and might invoke additional input from the user that will initiate

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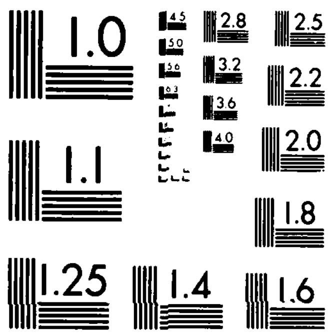

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further dialog or model processing. Upon an input from the user that no other processing is desired, or when processing arrives at a logical completion, the user may elect to either execute another Automated EEWS capability or to exit the system.

C. Component/Module Descriptions

In Paragraphs A and B above, we discussed the Automated EEWS from a total system view point. In this section we describe the components and subsystems that compose the total system. These are the Dialog Component, the Data Base Component, and the Modeling Component. Each of these subsystems has been designed to accomplish the specific functions outlined for each in Chapter III of this document.

1. Dialog Component Description

The Dialog Component is composed of three modules: the Dialog Constructor Module, the Dialog Access Module, and the Device Driver Module. The Dialog Constructor Module accomplishes those functions that develop and interpret user-system dialog and that specify system control actions based on response logic. The Dialog Access Module allows the user to select, from those system capabilities available to him or her, the specific capability to be exercised. The Device Driver Module serves as a translator for communications between specific input/output devices and the system. The separation of these functions offers several features to the Automated EEWS design. Specifically:

- New dialog capabilities can be added in a simple manner;
- New modeling components and associated dialog can be added directly to the Dialog Constructor Module without disrupting system operation;
- Multiple dialogs can be made available for the same Modeling Component;
- Dialogs are primarily device independent;

- The user can have multiple input/output devices; and
- New or additional input/output devices can be easily added to the system because all device specific code is isolated in the Device Driver Module.

These design features will allow a great deal of flexibility and adaptability in the system, while maintaining consistent user-system interface and dialog.

2. Data Base Component Description

The Data Base Component will initially consist of a single module, the Data Base Module. In later stages of our recommended evolutionary design, a second module will be added to provide the capability to interface with data sources external to the Automated EEWS. The Data Base Module will accomplish the functions normally associated with data base control including the functions of a Data Base Management System (DBMS). The Data Base Module provides all internal files used by the Automated EEWS for system processing. This will include: model base files; variable and parameter data files; response logic files; access logic files; temporary, intermediate, and final input/output files; working space; and memory aids. The DBMS used with the Automated EEWS will be a standard computer application system that provides for the creation, maintenance, validation, protection, access/retrieval, and updating of system files. The specific DBMS to be used with the Automated EEWS cannot be selected at this time because system hardware and available operating systems associated with that hardware have not been specifically selected; however, the DBMS that is selected will be one that provides the identified capabilities within the constraints of the hardware system selected. The data base files included in the Data Base Module will initially be established using standard data models to be dictated by the form of the information, the required use of the data, and the capability of the selected DBMS. Because of its simplicity, widespread understanding, universal application, and

supportability by most DBMS, we envision that the initial data model used in the Automated EEWS for data files will be the Record Model.

3. Modeling Component Description

The Modeling Component will consist of a Model Base Management System (MBMS) Module and a Model Base Module. The MBMS Module will provide the Dialog Component and Data Base Component linkages for the Modeling Component. The Dialog Component linkage will receive control action information from the Dialog Component based on response logic generated from user input. This information will contain all instructions necessary to perform model processing. Based on the interpretation of instructions, the Data Base Component linkage will extract necessary information from the Data Base Component data files. The MBMS Module then activates operation of the appropriate model contained in the Model Base Module. Results from model processing are then passed back to the MBMS Module for storage in the appropriate data file through the Data Base Component linkage. The Model Base Module is simply the set of all models, routines, subroutines, or programs included in the system.

D. Component/Module Logic Flow

The general system design previously described is intended to integrate a variety of decision support components into a unified system. This discussion is an extension of the previous description and provides specific design information for the subsystem comprising the Automated EEWS.

1. Dialog Component Logic Flow - User Access

The Automated EEWS is activated when the user logs on to the system by entering the assigned ID code on the screen displayed at the user terminal. As shown in Figure 4-3, this

information passes directly through the Input/Output Buffer Routine to the Access Management Routine of the Dialog Access Module. The Access Management Routine will then access the Access Logic File in the Data Base Component to determine if the ID Code is valid and, if so, extract a list of the system capabilities and data files available to a user with that specific code. This list is transmitted to the Output Format Routine that will prepare a menu from which the user can select the system capability to be executed. The menu is passed through the Input/Output Buffer Routine for display on the user terminal. The user will input the information necessary to identify the selected capability. This information will be passed back through the Input/Output Buffer to the Access Management Routine, which will again access the Access Logic file to determine if further user action is needed to activate the desired system capability. If such actions are needed, the Output Format Routine will prepare a display of appropriate actions required and pass the display through the Input/Output Buffer to the user terminal. An example of the type of action that might be required of the user is the entry of additional information such as the desired output device or the file name under which to store the output data. Once all required user actions have been completed, the Access Management Routine will transfer control to the Dialog Constructor Module to complete processing. When control is returned to the Access Management Routine, the user will be queried as to requirements for further processing. When the user elects to exit the system, the Dialog Access Module will perform any necessary administrative and housekeeping functions required.

2. Dialog Component Logic Flow - System Processing

As shown in Figure 4-4, the Dialog Component also contains a Device Driver Module and a Dialog Constructor Module. Each module contains a set of independent routines designed to provide one of the primary functions associated with the Dialog

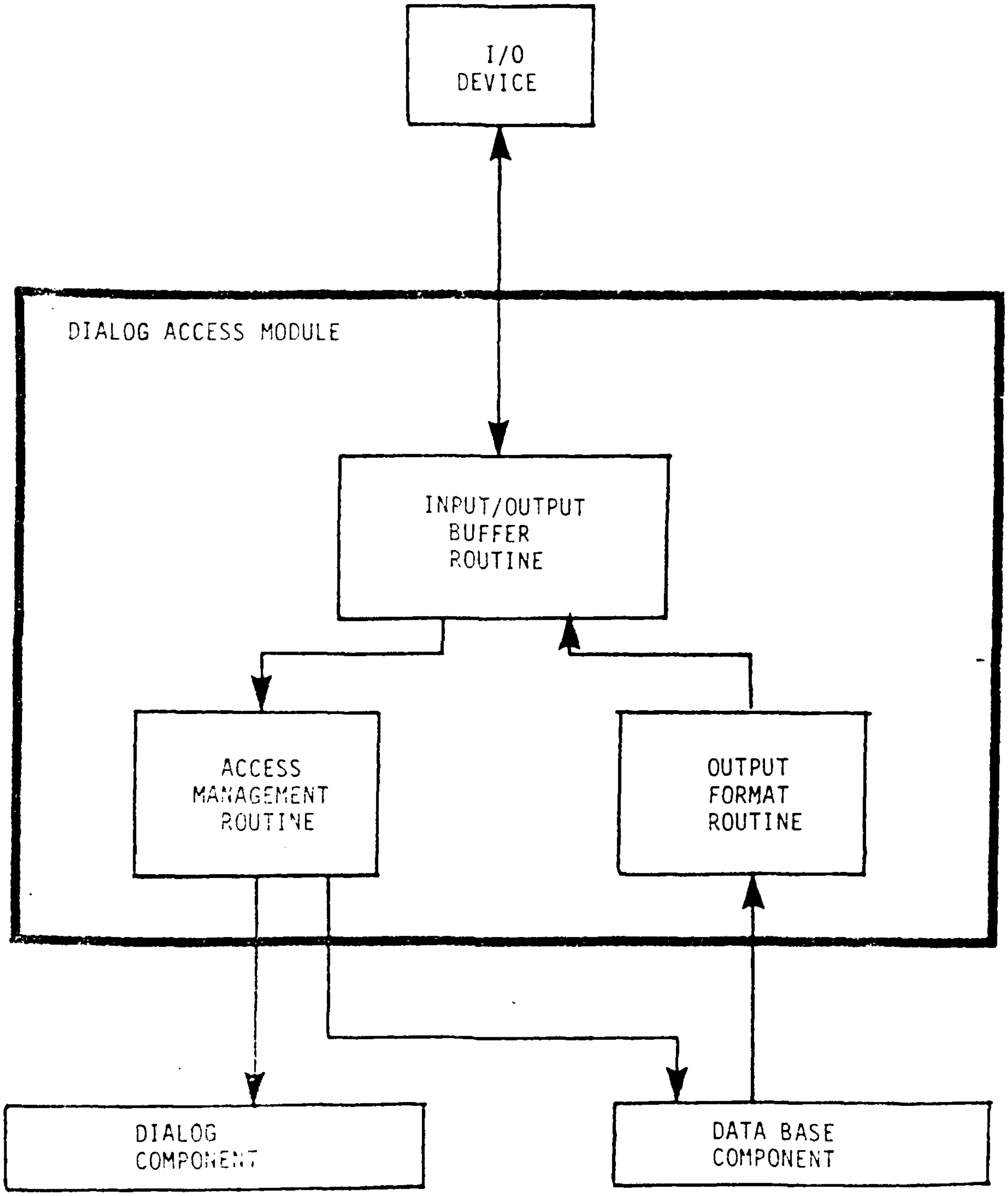


FIGURE 4-3. DIALOG ACCESS MODULE LOGIC FLOW

Component. When the Dialog Component is activated, it will lead the user through a dialog that will develop the control actions necessary to provide the support selected by the user. The dialog between the Automated EEWS and the user is conducted through a sequence of output displays and user provided inputs. When the user responds to a Dialog Component generated display, it is first processed through the Device Driver Module. Within this module, the input information is passed from Driver/Buffer Management Routine to the Device Input Function Routine. This routine translates the device-specific input into device-independent information and relays this information to the Input Format Routine in the Dialog Constructor Module. The Input Format Routine will develop control action commands based on information contained in the user input and from the Response Logic File of the Data Base Component. These control action commands are then passed to the Response Constructor Routine where they are interpreted and executed by either activating other appropriate system components or developing output display data and depositing them in temporary data files located in the Data Base Component. When a series of commands are to be executed, they may also be temporarily stored in the Data Base Component. Within the Dialog Constructor Module, the Output Format Routine retrieves output display data from the other system components. This information or data is then translated by the Output Format Routine into a device independent data structure that describes the output representation in terms of values to be displayed and how to display these values. This information is then passed to the Output Constructor Routine (also within the Dialog Constructor Module). The Output Constructor uses the description of the representation to identify functions that must be performed to create the specified representations on one or more output devices. These functional requirements are still device-independent and are passed to the Device Output Function Routine within the Device Driver Module. Here, the device-independent functional requirements are turned into device-specific commands which are

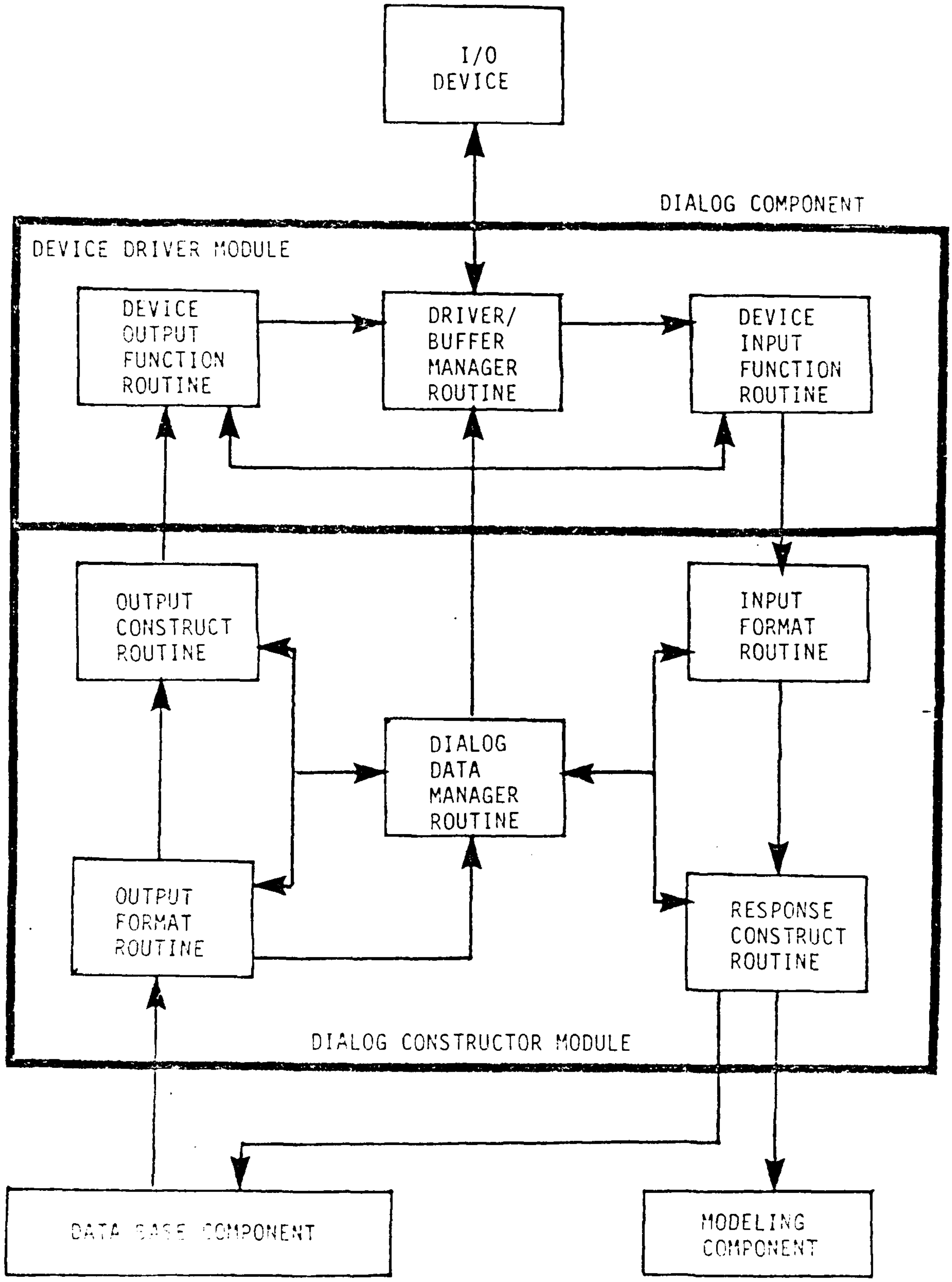


FIGURE 4-4. DIALOG COMPONENT LOGIC FLOW

passed through the Driver/Buffer Management Routine to the appropriate output device.

The Dialog Data Manager Routine manages all storage and retrieval of data used by other routines within the Dialog Component. This information may vary from values to be used in output representations to information input by the user.

3. Data Base Component Logic Flow

The Data Base Component does not contain internal logic other than that associated with the DBMS. As previously stated, the DBMS will be a standard commercial package selected to support the Automated EEWS based on its ability to provide all required functions identified. The specific logic of the DBMS cannot be specified until a particular package to be used is selected.

While the Data Base Component does not contain internal logic, the entry and retrieval of information contained in data files within the component does provide an extremely important part of the system logic. In particular, it is this part of the system operation that allows the integration of all system components. The use of the Data Base Component to provide system integration simplifies design, implementation, and maintenance of the system. The use of this integrating concept offers the following distinct advantages:

- The data base can be used to share information among the various Modeling Components within the structure;
- Where multiple Dialog Components are used in the structure, the data base can be used to share information between the various Dialog Components, and between the Dialog and Modeling Components;
- The data base can be used to store parameters for the Modeling Component. This separation of models and parameters makes modification to models easier;

- The data base can be used to store response logic and output formats for the Dialog Component; and

- Data Base management functions can be centered in the Data Base Component and do not need replication in Modeling or Dialog Components.

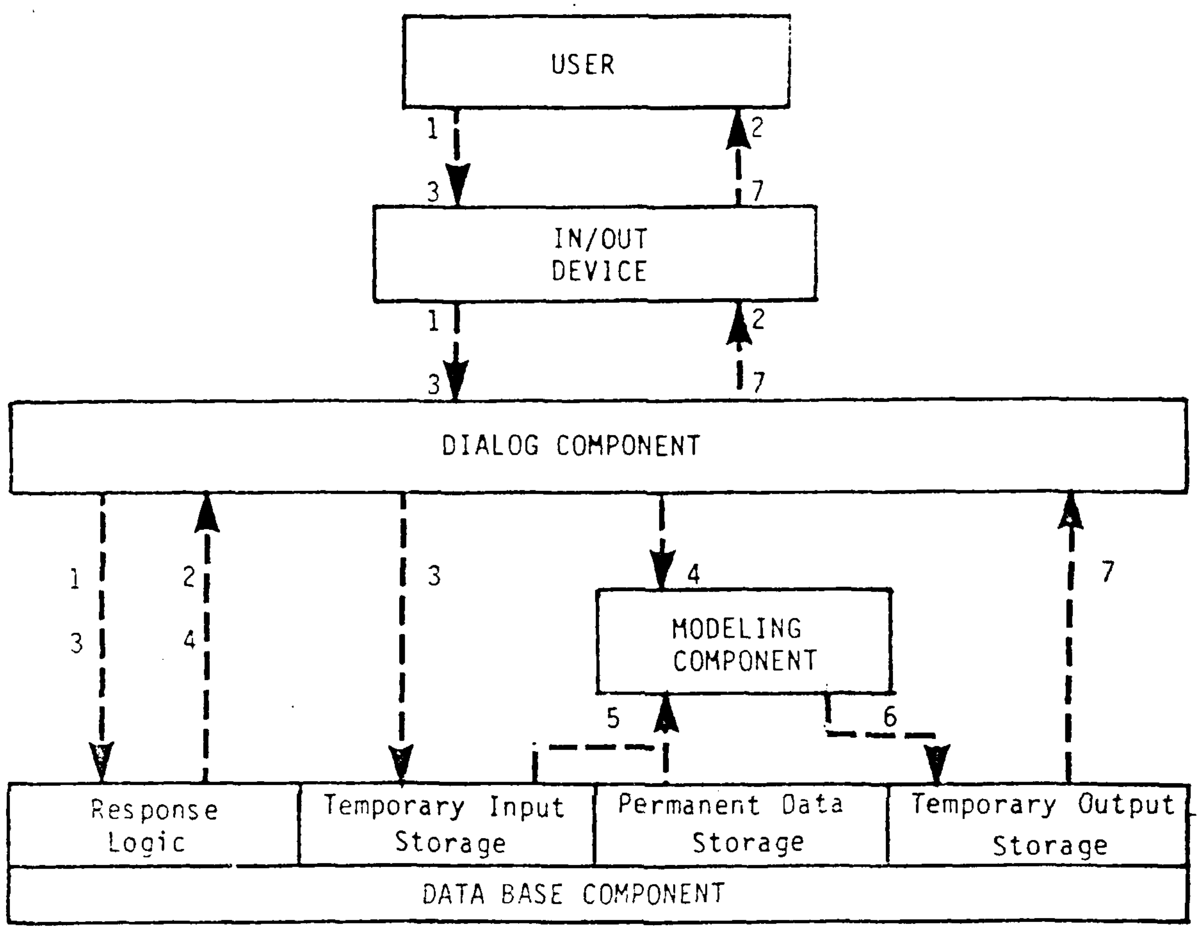
In general, using the data base as the integrating component simplifies the sharing of information among the components of the system. The basic logic for using the data base as the integrating component is displayed graphically in Figure 4-5. This figure portrays the logic in its simplest form and is not intended to restrict the design concept to this level of application.

4. Modeling Component Logic Flow

In general, logic included in the design of the Modeling Component must provide a base for a collection of models, programs, and routines. This collection must be subject to a set of model base management functions that enable the decision maker to utilize the component fully in the decision support process. Of extreme importance are the links between the Modeling Components and the other two components of the system. It is these linkages that provide integration of the system.

As shown in Figure 4-6, the Modeling Component is composed of the Model Base Module and the MBMS Module. The Model Base Module is simply the collection of models, programs, and routines. These models can be standard commercial software packages and each will contain their own particular logic.

The MBMS Module is composed of three routines: the Dialog Linkage Routine, the Data Base Linkage Routine, and the Model Management Routine. When the Modeling Component is activated by the Dialog Component, the Dialog Linkage Routine will receive specific instructions concerning model processing. These instructions will include: models to be used and specific



1 User requests execution of "Model A."

2 System responds to User by requesting certain modeling parameters.

3 User inputs specified modeling parameters which are stored in temporary memory.

4 Based on input of modeling parameters, logic indicates activation of Model.

5 Modeling Component accesses system memory and extracts necessary information for execution.

6 Results of model execution are stored in temporary memory.

7 Results of model execution are displayed to the user.

FIGURE 4-5. DATA BASE COMPONENT LOGIC FLOW

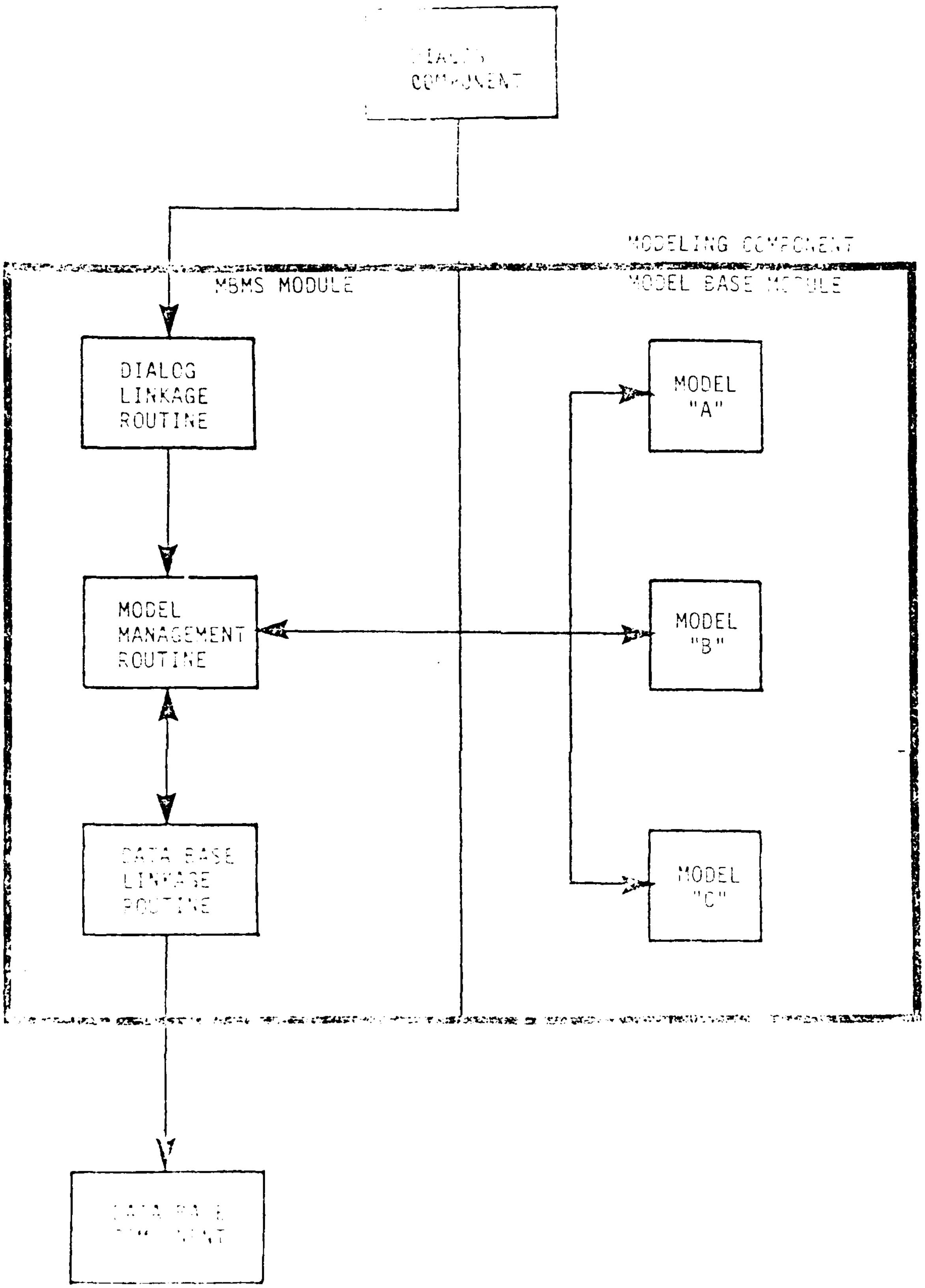


FIGURE 3-[illegible]. MODELING COMPONENT LOGIC FLOW

options to be exercised; sequence of model processing; data files to be used; variables and parameters of interest; intermediate data to be passed between models; output data format; and which data files the output results are to be stored in. The Dialog Linkage Routine will interpret these instructions and develop a set of commands for model processing. These commands are passed to the Model Management Routine for execution. This routine will activate the Data Base Linkage, which will extract necessary information from appropriate Data Base Component files. The Model Management Routine will then activate specific models within the Model Base Module for information processing. Results from model processing will be passed to the MBMS for storage in the appropriate data files of the Data Base Component by the Data Base Linkage Routine.

In designing the Dialog Linkage Routine, two primary considerations must be kept in mind. First, model results are not transmitted from the model to the Dialog Component for output. This information is passed to the data base and extracted for output by the Dialog Component. The second primary consideration is that, unlike traditional model-user interaction, the sequencing of dialog messages between the model and the user of a DSS is flexible, and determined by the user, not the model.

The Data Base Linkage Routine is the integrator of system models and the data base. The design of this routine must provide mechanisms that allow each model to obtain all values and input data from the data base.

This provides accuracy because all values used will then be subject to the validity and checking procedures of the DBMS. Mechanisms must also be provided that allow all models to use the same data base to provide consistency between models and currency of each model and that allow output from a model to be

SAMPLE ORGANIZATION

of

MONTHLY REPORT ON STATUS OF SERVICE RECRUITING

SECTION 1: TRENDS IN SERVICE CONTRACTS -- OCTOBER 1979-PRESENT

SECTION 2: FORECASTS OF SERVICE CONTRACTS VERSUS CONTRACT GOALS

SECTION 3: TRENDS IN LEADING AND CURRENT INDICATORS OCTOBER 1979-PRESENT

SECTION 4: TRENDS AND PROJECTIONS OR ASSUMPTIONS REGARDING SUPPLY FACTORS OCTOBER 1979-PRESENT

Section Three contains forecasts of unemployment and supporting information on trends in unemployment, leading economic indicators, applicants, and high-quality contracts in bellweather districts. It tracks the conversion rate of leads and applicants into contracts, and it monitors the delayed entry pool. These figures would be very important in corroborating that changes that might occur in the next six months.

Section Four provides trends on supply factors -- population, pay, and recruiting resources. It also includes trends in goals and policies. These data would be of use in establishing whether a decline in enlistments was caused by changes in supply or by changes in demand factors, i.e., goals and policies. An appraisal of these data would be an essential part of the procedure for reducing the incidence of false alarms.

APPENDIX A

SAMPLE ORGANIZATION OF MONTHLY REPORT ON STATUS OF SERVICE RECRUITING

The monthly report of the EEWS will signal whether there is an alert in the current month or in any of the next six months. It will also provide additional data for undertaking a timely, complete and credible assessment of the recruiting market by the Human Assessment Group.

The EEWS monthly report which we are proposing would include a large amount of data that would be useful and necessary for a complete assessment. Some services may prefer that the EEWS provide a less detailed report because some of these data are available from other systems. The EEWS will be flexible enough to allow for tailoring of reports in order to accommodate the Services' particular needs. Certain tables or figures could be omitted or new ones could be developed. However, we urge the Services to have all of the proposed data available to The Human Assessment Group, either from EEWS or another system.

In the following pages is presented a table of contents for the proposed report and prototype samples of the graphs, charts, and table that would be included. The samples are <u>only simulations</u> and do not represent the actual data. However, to enhance the simulation, the samples assume a March 1984 report. The sample report is divided into four sections.

Section One of the proposed report provides an historical perspective of the recruiting market since October 1979. It includes figures illustrating trends in total and high-quality contracts for various cohorts. It also includes a comparison of contracts and goals.

Section Two indicates whether there are alerts in the reported month or in any of the following six months. It gives a probability of achieving goal for high-quality NPS male contracts for each month and for the year to date, up to the next six months. It also forecasts short falls by month and for the year to date, and track changes in enlistments relative to previous years. This is the critical section for signaling an alert.

APPENDIX A

CHAPTER V

POTENTIAL PROBLEMS

A. Identification of Potential Problems

It is important to recognize potential problems/obstacles early in order to develop solutions or acceptable alternative procedures. At this time, two potential problems/obstacles have been identified regarding the incorporation of the Automated EEWS.

- o Site selection needs to be finalized before a detailed system design can be undertaken. Until this decision is made, precise costing for Stage II cannot be made. Any further delay in this decision, would probably delay system implementation.
- o ERL has developed the Monitoring and Forecasting Algorithms of EEWS utilizing SAS software. If a particular site cannot support SAS, provisions must be made for other methods.

The significance of these problems is further discussed in Paragraph B, below.

B. Discussion of Potential Problems

With reference to the first obstacle, once a decision has been made concerning the site location a detailed system design can be undertaken. In order for the system to be developed in a timely manner the Services and OSD must decide upon how and where the system will be implemented before the next stage of this project is initiated. The second potential obstacle identified should not pose a significant problem. The majority of possible processing sites will support the SAS statistical package. If not, there are other available statistical packages that could be adapted for use to the system.

- Data elements are not brought to models (in the user's perception); rather, models are brought to those parts of the program in view. For instance, while viewing a recruiting resource with all its information, the user may point at two of the data fields and ask for a correlation of the two across all recruiting resources. This is a much different experience for the user than a system in which the user first picks "correlation" from a menu, then "recruiting resources" from the next menu, and so forth.

Again, for a more complete discussion of the "programmatic" design approach, the reader is referred to Appendix B.

K. System Security

At this time, the Automated EEWS is not expected to process classified data. Therefore, the main concern for the DSS will entail maintaining data security for the individual Service data. This entails restricting portions of the data base to access only by authorized users. Security will be maintained by masking the data of each service so that each user will have access only to their specific data while the data of the other users is consolidated to insure its confidentiality. Specific system security procedures will be specified upon design and development of the system.

of the items. The user may select any item on the list, change its value, and receive explicit feedback that it has been changed by seeing the list re-displayed with the new value for the item. For this form of control, each item on the list is considered an independent variable. That is, there are no constraints on the combinations of values that the items on the list can assume, plus a change in the value of the item does not affect the value of any other item. Note, this option is analogous to full screen data entry/editing.

These formats have been defined in terms that are as free as possible from descriptions of the mechanisms of control and display. They refer to the way the user should perceive the control and feedback constructs of the system independent of how they are achieved.

Another important concept that will be applied during the design of the Automated EEWS Dialog Component is one in which the substance of user-system interaction is "programmatic." By this, we mean that the context of the dialog is specifically designed to focus the user's attention on the particular decision/problem being addressed. This concept is a significant advance over that used in most DSS. The architectural structure we have proposed supports the application of this concept in the Automated EEWS. The following are examples of features that might be included in a system that is designed based on the "programmatic" concept.

- "Indexed Topical Notebooks" are used in preference to simple scratch pads. Such a notebook has a topic (e.g., recruiters), a table of contents, and is "loose leaf." The scratch pad has no topic and no index.

- Queries are "by example" rather than a general query language. For instance, to find the values of leading indicators associated with particular recruiting regions or districts, the user can be shown the generic display stating "leading indicator" to which the name of the region can be entered at the appropriate location. The system would look for all leading indicators associated with that area.

- Most report generation is done in preformatted fashion to replicate EEWS displays of the program. The user does not need to reformat information for these reports.

I. Automated EEWS Flexibility

The design of the Automated EEWS will be top-down and of modular structure to provide maximum flexibility for future system modifications resulting from changes in either technology or operational needs. Our recommended approach to developing system capabilities in an iterative fashion allows a great deal of flexibility in what support the system can provide. This evolutionary approach to the system design, coupled with the software architectural structure selected for the system, provides additional adaptability and flexibility to the Automated EEWS.

J. Human Factors

Appendix B of this Report provides a detailed discussion on how a DSS should be designed to integrate the user into the system. The information contained in this appendix is based on a joint study previously performed by Advanced Technology and Decisions Design, Inc. for the Defense Systems Management College (DSMC) concerning the human factors involved in the design of a DSS to support the Program Manager's Support System (PMSS). The information contained in Appendix B has been extracted, in part, from the report provided to DSMC. The concepts described in this discussion will serve as a basis for the design of the Dialog and Modeling Component of the Automated EEWS. Of particular importance are the recommended dialog formats to be used for the enhancement of user-system interaction. The two format types recommended for the initial system design include:

- Format 1: The user selects one or more options from a menu and receives no explicit feedback from the system as it proceeds to the next menu option. Implicit feedback occurs when the system changes the display (e.g., presents a lower-level menu) as it carries out the options selected by the user. Command (function key) driven controls in which the commands are displayed for the user are considered menu-driven systems.

- Format 2: The user receives a list (menu) of control items for which values can be changed, as well as the current values

During Stage II, the Automated EEWS will be migrated to user processing sites for those users who desire it. It is assumed that each user processing site will provide a similar hardware environment as the central site. However, no major problems are envisioned for a different environment so long as it is a standard environment. In this phase, two data bases will be maintained. The central data base will contain/maintain all information needed to operate the system for all users. The second data base, maintained by the user at the user processing site, will contain the information necessary for that user to process the system and any unique information desired by the user. Users will update the central data base by providing information to the data manager in the same method as used in Stage I. At the same time the users will update their own data base with this information. The data manager will supply each user with required information received from other sources. Periodic data base dumps will be provided by the data manager to assure validity of the user's data base. Stage III environment will be the same as Stage II, except that data updates of the central data base and the users' data bases will be accomplished via computer interface.

2. <u>Software Environment</u>

As indicated in Paragraph H.1 above, operating software and support software will be site dependent. It is envisioned that this will be standard software. The EEWS model will be programmed in a higher order language. The graphics package included in the system will be off-the-shelf software selected to operate in the environment provided. Any models added to the system during Stage II will be off-the-shelf packages, existing user models, or models specifically designed for the Automated EEWS.

These files are normally deleted when no longer needed by the system. However, upon user command, Output Data files can be retained for use at a later date. This capability is not associated with temporary or working files.

H. System Environment

This section describes the system environment envisioned to support operation of the Automated EEWS. While the selection of the central processing site has not been finalized, it is assumed that the Automated EEWS will operate on existing hardware, the associated operating system, and existing support software. Because a site has not been selected, the discussion of system environment will be somewhat general in nature. Once a processing site has been selected, the system environment can be specifically defined. This specific definition must be completed before final design efforts can be initiated. The system environment for the Automated EEWS is addressed from the aspect of both hardware and software environments.

1. Equipment Environment

One of the assumptions described in Chapter II was that the Automated EEWS would be initially installed during Phase I at a central processing site and that users would access the system in a time sharing mode. It is assumed that the processing site that is selected will provide a mainframe processing environment that is supported by a standard operating system and support software. It is also assumed that all users will have communication access to the central processing site and that each user will have the necessary terminal equipment and output devices to use the system. The central data base will be located at the central site and will be updated monthly by the Services and OSD. It is expected that update will be accomplished via tapes provided by the data supplier to the data manager.

2. Program Library Files

These files contain a list of all programs contained in the Model Base along with specific instructions for activating and processing each program. These files would be constructed when the Automated EEWS is implemented at a site. These files would require updating whenever the contents of the Model Base are changed or when procedures associated with a particular program are changed.

3. Response Logic Files

These files are developed along with the design of user-system dialog and contain control action information used in exercising system capabilities. These files must contain information to translate user responses in system control actions and to translate processing results into output display development information. These files require update with any change in the design of user-system dialog.

4. Parameter Value Data Files

These files provide specific data values to support model processing. They will contain data for the variables discussed in Volume IV. They may be particular to a specific program or may be shared by several programs. These files may also be developed in a hierarchical form to support processing. Update of these files will normally occur on a monthly basis or whenever parameter values change.

5. Temporary and Output Data Files

During the performance of system capabilities, these files are developed to temporarily store information needed for subsequent use in the system or for output from the system.

G. Automated EEWS Data

This section provides a brief description of the type and contents of data/information files needed to support the Automated EEWS. These files can be classified into six general classes:

- o Access Logic Files;
- o Program Library Files;
- o Response Logic Files;
- o Parameter Value Data Files;
- o Temporary (working) Data Files; and
- o Output Data Files.

The first four classes are considered permanent files, while the last two are generally considered temporary. As previously discussed, the files will be controlled and maintained by a standard DBMS package. The data model format for the files is planned to be a record format. Specific data elements included in each file along with the appropriate data sources will be determined during detailed system design. Backup and recovery procedures will also be determined at that time.

1. Access Logic Files

This set of data files will contain the specific information needed to control access to the system and to specify capabilities within the system. The files will be constructed when the Automated EEWS is implemented at a site and must be updated whenever capabilities or authorized users are added to or deleted from the system. They must also be updated whenever specific capabilities available to a user are changed. At a minimum, these files must contain a user identification code for each authorized user and a list of capabilities available to that user.

The graphic package included in the Automated EEWS will be one of the available commercial packages. It will supply bar charts, pie charts, graphs, etc., along with color graphic capabilities. SAS-Graph is a distinct possibility for the system because of its versatility. In addition to possessing the above capabilities, SAS-Graph also has the ability to produce maps and three dimensional plots. SAS-Graph is also compatible with a number of plotters and printers commercially available.

The Report Generator Module will be custom developed for the system. Once standard report formats have been established, this module will be fairly standard in use. The user will be required only to prompt the system whenever data has been updated to produce reports for the current period. Also there will be a capability for the user to produce ad hoc reports. This feature will allow the system more flexibility in the reporting process.

During the second stage of system development, software will be added as specified by the Services. It is envisioned that new software incorporated into the system will be primarily of an analytical nature. There are several commercial analytical packages available that could be included in the system. Examples of these are: SAS for statistical analysis and Spreadsheets for "What If" analysis. In addition to commerical software, existing Service models (such as a recruitment policy analysis model) or models developed specifically for the Automated EEWS could be added to the system.

F. Interfaces

At this time there are no plans to interface the Automated EEWS with any external systems or data sources during this initial stage of design. Interface with external systems or external data sources, if desired by the Services, would take place during Stages II and III of the development.

transmitted to the Data Base Component and stored there for use by the Dialog Component and/or other Modeling Components. The storage of model output in the data base provides a linkage between models as well as allowing the Dialog Component to display, format, and present model output.

E. Program Descriptions

The Stage I design of the Automated EEWS will provide decision support capabilities in two areas. These areas and their associated software include:

- o Decision Support:
  - Monitoring algorithms to track the current recruiting market.
  - Forecasting algorithms to supply projections for the market in the near future.
- o User Support:
  - Graphics display and output.
  - Standard Report Generator.

The system will use separate models for both the monitoring and forecasting algorithms; however, both models must be processed by the system to produce forecasts. The reason for this is that the forecasting algorithms are comprised of data dependent upon the results of the monitoring algorithms. At this time, it is envisioned that these algorithms will be programmed using SAS. The forecasting and monitoring algorithms are currently under development by Economics Research Laboratory (ERL). These models will be custom developed for the EEWS system and will be designed to be an integral part of the system.

SECTION ONE

RECENT TRENDS IN ARMY CONTRACTS

EXAMPLES OF CONTENTS

(TIME PROFILE GRAPHS WITH DATABASE TABLES AVAILABLE)

FIGURE 1: RECENT TRENDS IN ENLISTMENT CONTRACTS FOR THE SERVICE (SEE FIGURE A-1.)

- ALL NPS MALE CONTRACTS
- ALL FEMALE CONTRACTS
- ALL PRIOR SERVICE CONTRACTS
- TOTAL CONTRACTS

FIGURE 2: RECENT TRENDS IN NPS MALE ENLISTMENT CONTRACTS FOR THE SERVICE

- HSDG BY MENTAL CATEGORY
- SENIORS BY MENTAL CATEGORY
- NONHSDG BY MENTAL CATGEGORY
- TOTAL NPS MALE CONTRACTS

FIGURE 3 RECENT TRENDS IN PERCENTAGE COMPOSITION OF NPS MALE ENLISTMENT CONTRACTS FOR THE SERVICE (BY EDUCATIONAL AND MENTAL-CATEGORY COHORT)

FIGURE 4: RECENT TRENDS IN HIGH QUALITY NPS MALE ENLISTMENT CONTRACTS FOR THE SERVICE (BY EDUCATIONAL AND MENTAL-CATEGORY COHORT) (SEE FIGURE A-2.)

FIGURE 5: RECENT TRENDS IN HIGH QUALITY NPS MALE ENLISTMENT CONTRACTS AS A PERCENT OF TOTAL MALE CONTRACTS FOR THE SERVICE (BY EDUCATIONAL AND MENTAL-CATEGORY COHORT)

FIGURE 6: CONTRACTS VERSUS GOALS BY QUALITY COHORT AND ALL NPS MALE CONTRACTS FOR THE SERVICE

PROTOTYPE SAMPLE

	HSDG			SENIORS			NONHSDG		TOTAL
	1-3A	3B	4-5	1-3A	3B	4-5	1-3A	3B	
7910	00000	00000	00000	00000	00000	00000	00000	00000	00000
7911	00000	00000	00000	00000	00000	00000	00000	00000	00000
7912	00000	00000	00000	00000	00000	00000	00000	00000	00000
8001	00000	00000	00000	00000	00000	00000	00000	00000	00000
8002	00000	00000	00000	00000	00000	00000	00000	00000	00000
8003	00000	00000	00000	00000	00000	00000	00000	00000	00000
8004	00000	00000	00000	00000	00000	00000	00000	00000	00000
8005	00000	00000	00000	00000	00000	00000	00000	00000	00000
8006	00000	00000	00000	00000	00000	00000	00000	00000	00000
8007	00000	00000	00000	00000	00000	00000	00000	00000	00000
8008	00000	00000	00000	00000	00000	00000	00000	00000	00000
8009	00000	00000	00000	00000	00000	00000	00000	00000	00000
8010	00000	00000	00000	00000	00000	00000	00000	00000	00000
8011	00000	00000	00000	00000	00000	00000	00000	00000	00000
8012	00000	00000	00000	00000	00000	00000	00000	00000	00000
8101	00000	00000	00000	00000	00000	00000	00000	00000	00000
8102	00000	00000	00000	00000	00000	00000	00000	00000	00000
8103	00000	00000	00000	00000	00000	00000	00000	00000	00000
8104	00000	00000	00000	00000	00000	00000	00000	00000	00000
8105	00000	00000	00000	00000	00000	00000	00000	00000	00000
8106	00000	00000	00000	00000	00000	00000	00000	00000	00000
8107	00000	00000	00000	00000	00000	00000	00000	00000	00000
8108	00000	00000	00000	00000	00000	00000	00000	00000	00000
8109	00000	00000	00000	00000	00000	00000	00000	00000	00000
8110	00000	00000	00000	00000	00000	00000	00000	00000	00000
8111	00000	00000	00000	00000	00000	00000	00000	00000	00000
8112	00000	00000	00000	00000	00000	00000	00000	00000	00000
8201	00000	00000	00000	00000	00000	00000	00000	00000	00000
8202	00000	00000	00000	00000	00000	00000	00000	00000	00000
8203	00000	00000	00000	00000	00000	00000	00000	00000	00000
8204	00000	00000	00000	00000	00000	00000	00000	00000	00000
8205	00000	00000	00000	00000	00000	00000	00000	00000	00000
8206	00000	00000	00000	00000	00000	00000	00000	00000	00000
8207	00000	00000	00000	00000	00000	00000	00000	00000	00000
8208	00000	00000	00000	00000	00000	00000	00000	00000	00000
8209	00000	00000	00000	00000	00000	00000	00000	00000	00000

FIGURE A-1. RECENT TRENDS IN NPS MALE ENLISTMENT CONTRACTS FOR THE ARMY

PROTOTYPE SAMPLE

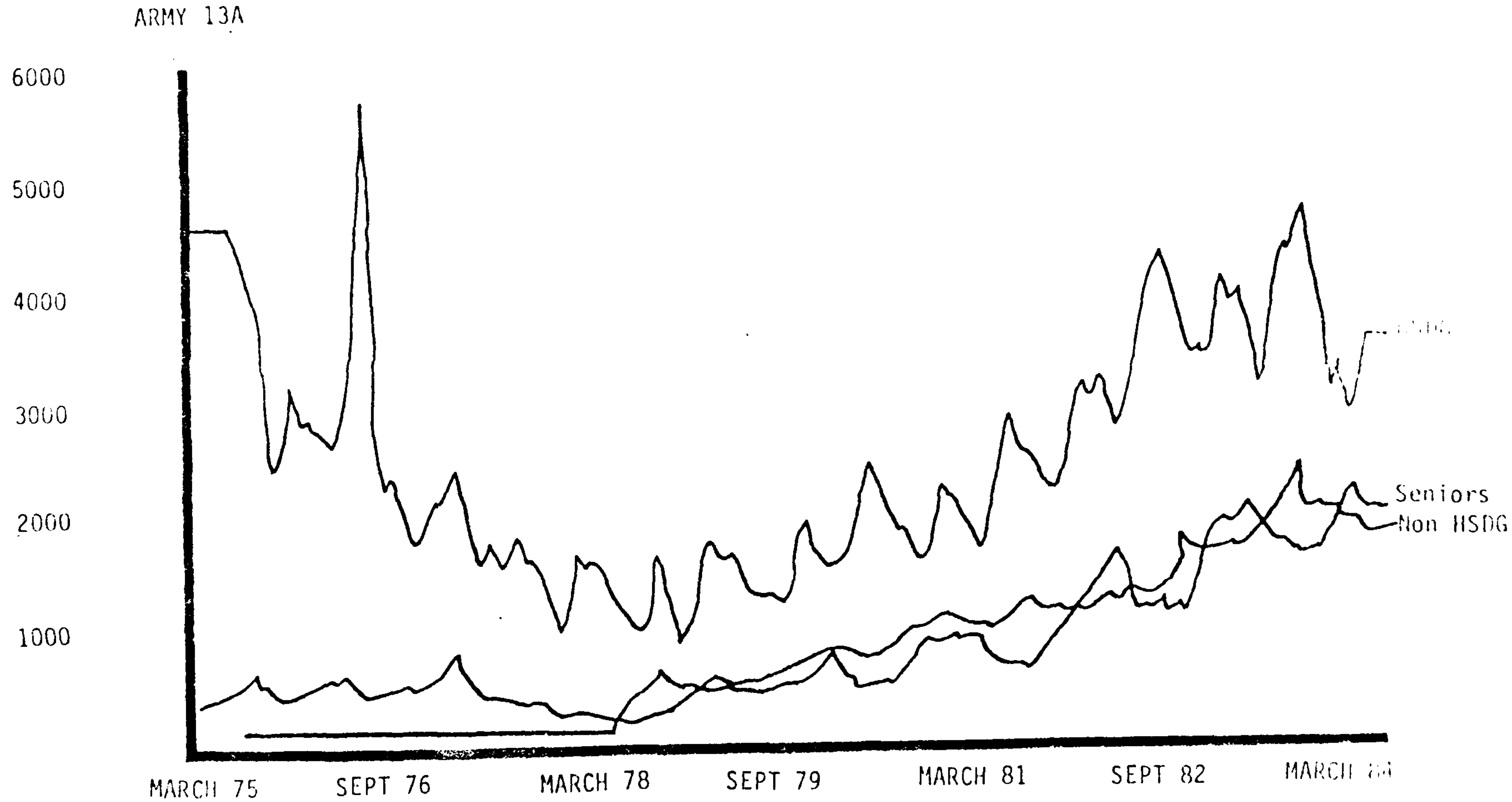


FIGURE A-2. ARMY NPS MALE 13A CONTRACTS

SECTION TWO
FORECASTS OF SERVICE CONTRACTS VERSUS CONTRACT GOALS

EXAMPLES OF CONTENTS

(TIME-PROFILE GRAPHS OF BAR CHARTS WITH DATABASE TABLES AVAILABLE)

PROTOTYPE SAMPLE

DISTRIBUTION OF ALERTS

SERVICE	MARCH 1984	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	TOTAL
ARMY	N	Y	N	Y	N	N	N	2
NAVY	N	Y	N	N	N	N	N	1
USAF	N	Y	N	Y	N	N	N	2
USMC	N	N	N	N	N	N	N	0

FIGURE A-3. DISTRIBUTION, OF ALERTS FOR SERVICES BY MONTH

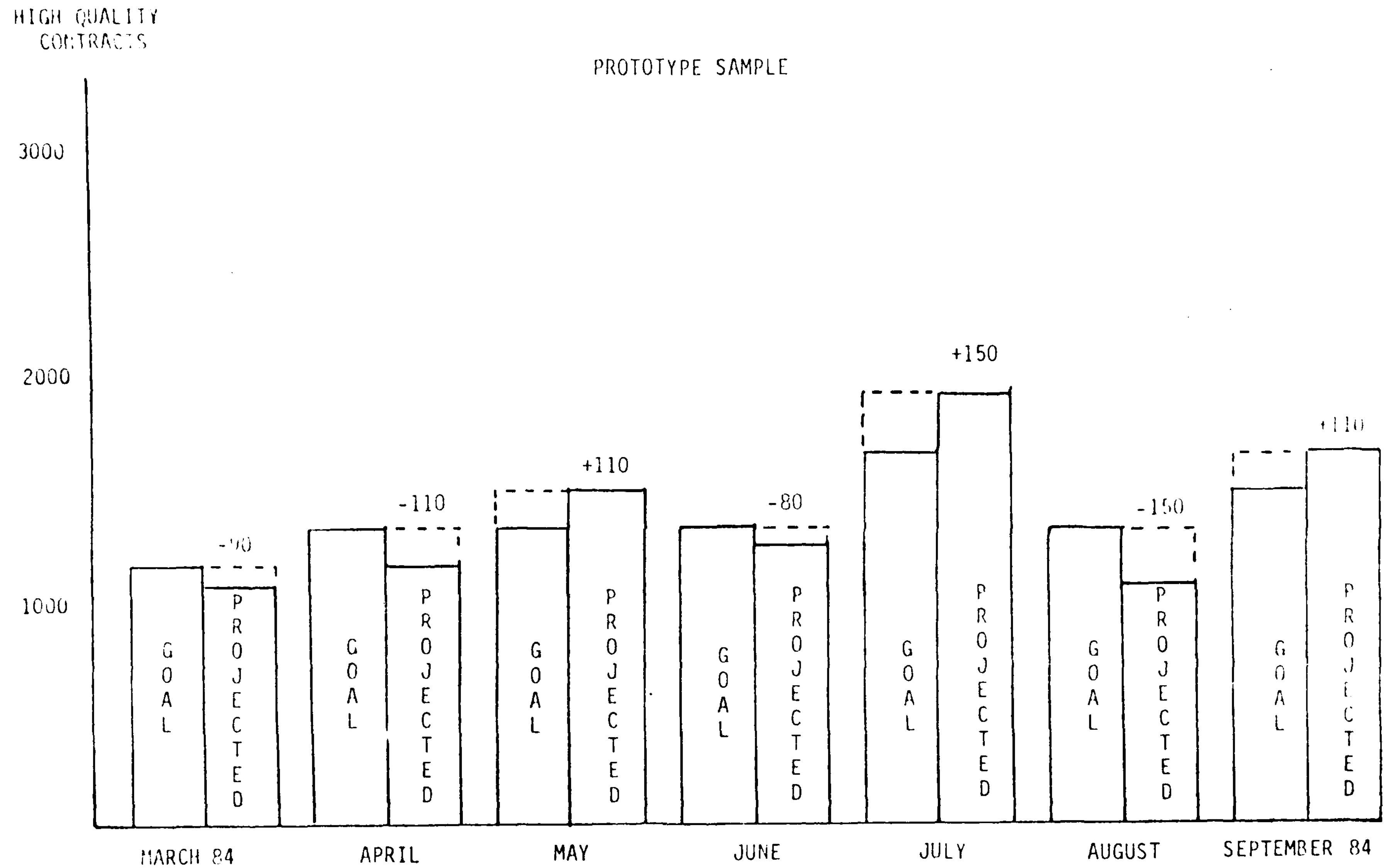


FIGURE A-4. GOALS VERSUS FORECASTS OF NPS MALE HIGH QUALITY CONTRACTS

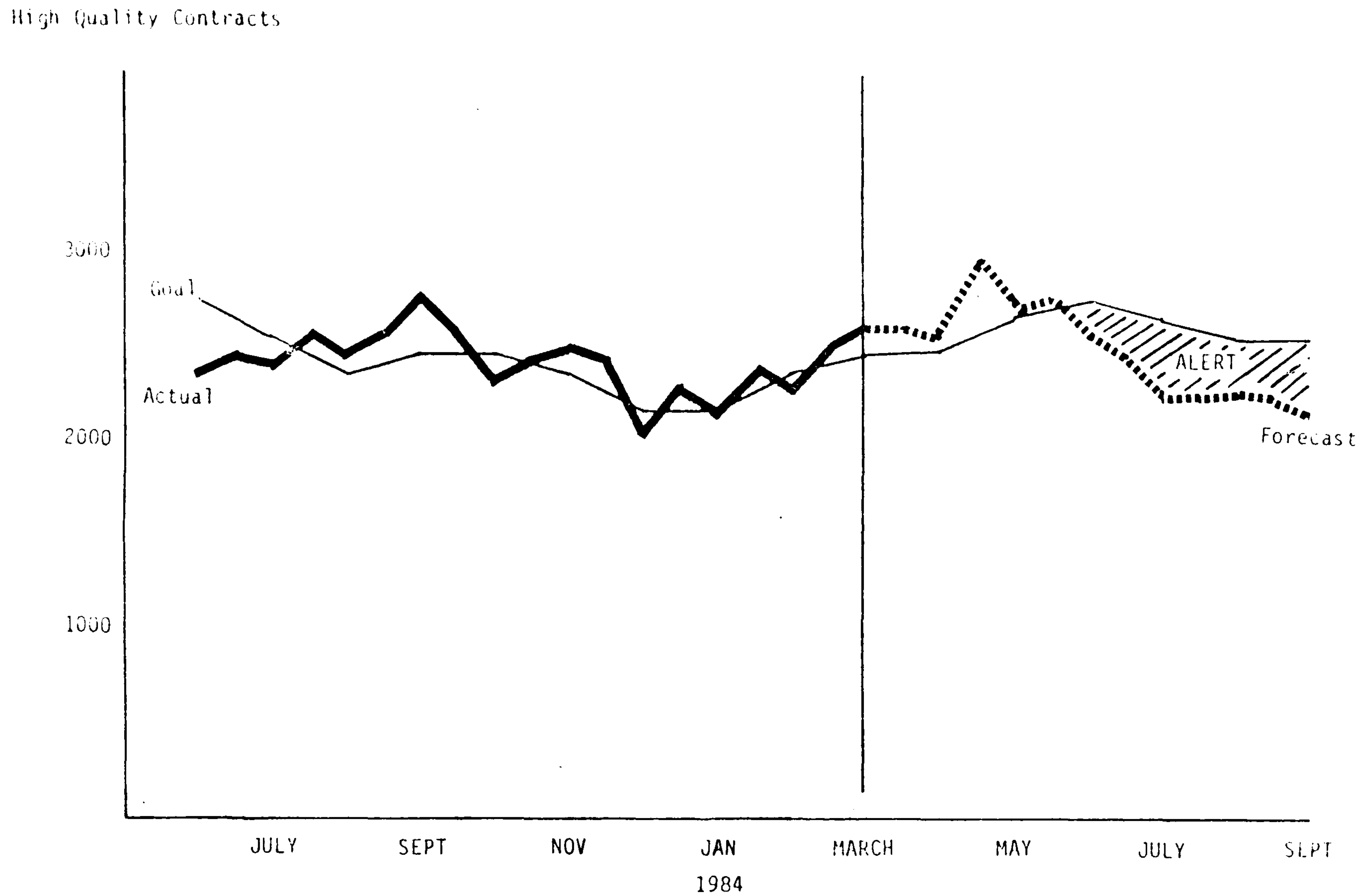


FIGURE A-5. GOALS, ACTUAL AND FORECASTS OF HIGH QUALITY CONTRACTS

SECTION THREE
RECENT TENDS IN LEADING AND CURRENT INDICATORS

EXAMPLES OF CONTENTS
(TIME-PROFILE GRAPHS OR BAR CHARTS WITH DATABASE TABLES AVAILABLE)

FIGURE 1: TRENDS AND FORECASTS OF **UNEMPLOYMENT:** MALES 16 AND OVER, MALE YOUTH 16 TO 19

FIGURE 2: **PERCENT CHANGES** IN UNEMPLOYMENT

FIGURE 3: UNEMPLOYMENT **COMPARED** WITH NPS MALE HIGH QUALITY CONTRACTS

FIGURE 4: **DESEASONALIZED** UNEMPLOYMENT VERSUS DESEASONALIZED NPS MALE HIGH QUALITY CONTRACTS (USING X-11)

FIGURE 5: MULTIVARIABLE PLOTS OF UNEMPLOYMENT AND OTHER **ECONOMIC INDICATORS** (SEE FIGURE A-6.)

FIGURE 6: NPS MALE HIGH QUALITY **APPLICANTS** VERSUS CONTRACT

FIGURE 7: **PERCENT** OF NPS MALE HIGH QUALITY CONTRACTS PER APPLICANT (SEE FIGURE A-7.)

FIGURE 8: TRENDS IN **LEADS** VERSUS NPS MALE HIGH QUALITY CONTRACTS

FIGURE 9: ANALYSES OF **DELAYED ENTRY POOL:** GROSS INFLOWS, STOCK, ATTRITION

FIGURE 10: MULTIVARIABLE PLOTS OF **BELLWEATHER DISTRICTS** AND NPS MALE HIGH QUALITY CONTRACTS

FIGURE 11: **DISTRICT-LEVEL** GROWTH RATE STATISTICS: AVERAGE GROWTH RATE RELATIVE TO SAME MONTH IN PREVIOUS YEAR; NUMBER GROWING VERSUS NUMBER DECLINING

PROTOTYPE SAMPLE

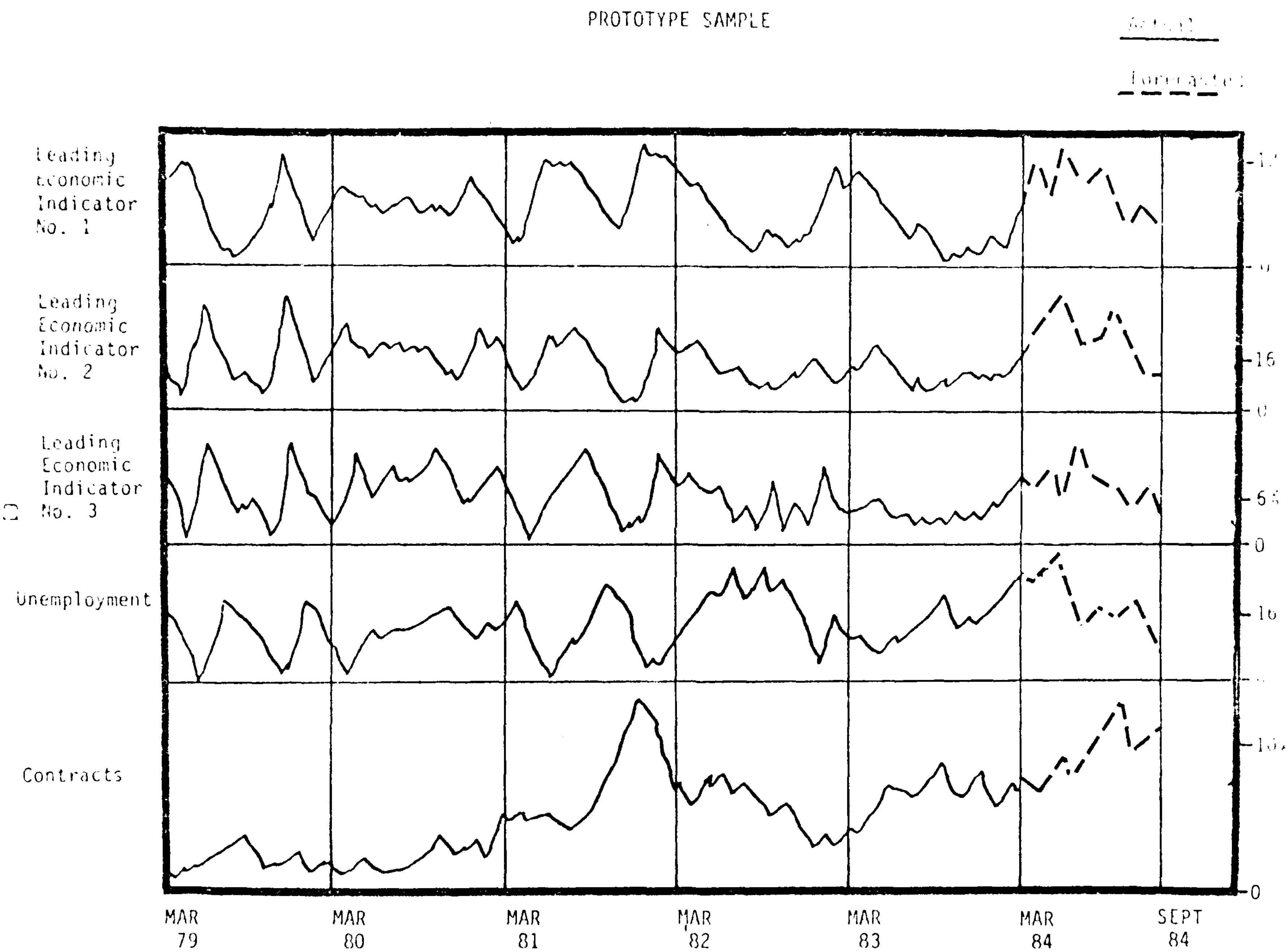


FIGURE A-6. 5 WAY PLOT COMPARING LEADING ECONOMIC INDICATORS, UNEMPLOYMENT AND CONTRACTS

PROTOTYPE SAMPLE

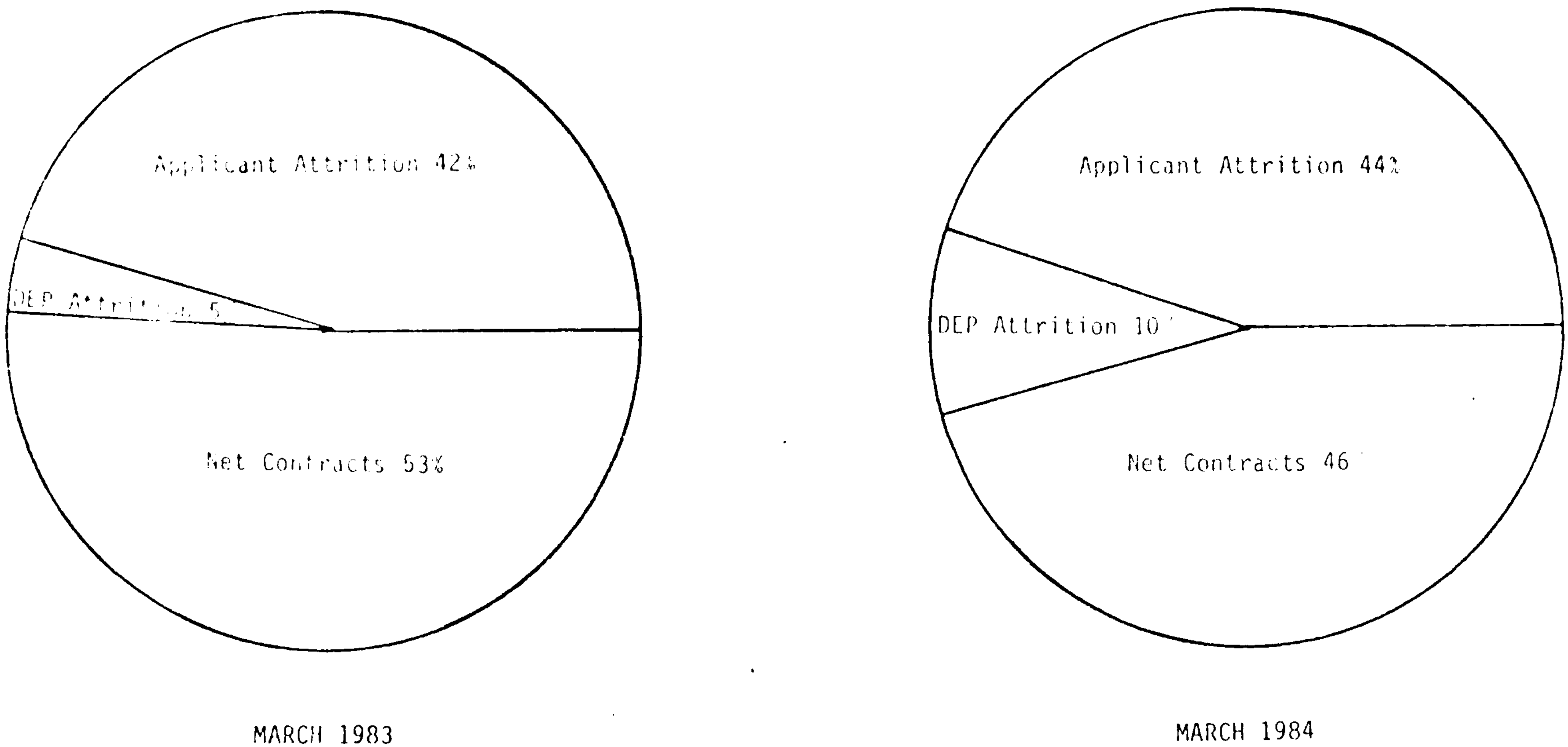


FIGURE A-7. NET CONTRACTS WITH APPLICANT AND DEP ATTRITION

SECTION FOUR
TRENDS AND PROJECTIONS OR ASSUMPTIONS REGARDING SUPPLY FACTORS

EXAMPLES OF CONTENTS
(TIME-PROFILE GRAPHS OF BAR CHARTS WITH DATABASE TABLES AVAILABLE)

FIGURE 1: NATIONAL TRENDS IN ALL MALE YOUTH POPULATION

FIGURE 2: CIVILIAN AND MILITARY PAY

- o GROWTH RATE OF EACH
- o RATIO BETWEEN THE TWO
- o TRENDS AND FORECASTS OF RELATIVE MILITARY PAY BY MONTH THIS YEAR VERSUS SAME MONTH LAST YEAR

FIGURE 3: RECRUITING RESOURCES

- o RECRUITER AND ADVERTISING EXPENDITURES BY YEAR
- o TRENDS AND FORECASTS OF RECRUITERS BY MONTH THIS YEAR VERSUS SAME MONTH LAST YEAR
- o TRENDS AND FORECASTS OF ADVERTISING EXPENDITURES BY MONTH THIS YEAR VERSUS SAME MONTH LAST YEAR

FIGURE 4: GOALS BY MONTH MARCH 1983 - SEPTEMBER 1984

- o TOTAL
- o NPS MALE HIGH QUALITY
- o NPS FEMALE HIGH QUALITY
- o PRIOR SERVICE

FIGURE 5: TIMELINE RECORD OF POLICY CHANGES THAT EXPAND/CONTRACT FLOW OF CONTRACTS (SEE FIGURE A-8.)

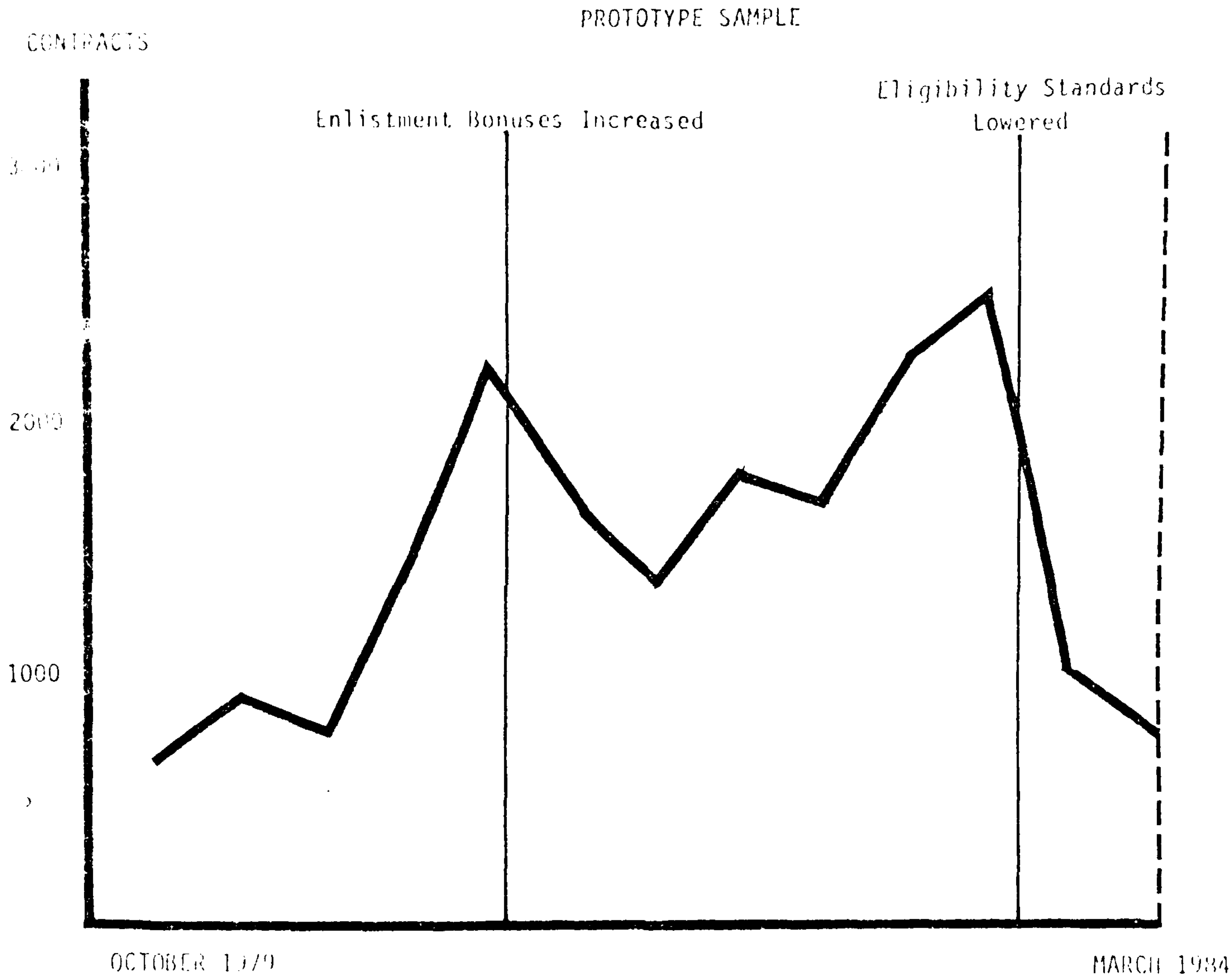


FIGURE A-8. TRACKING OF CONTRACTS AND INCIDENTS OF PROGRAM AND POLICY CHANGES

APPENDIX B

DSS DESIGN TO INTEGRATE THE USER

A. Dialog Component Architecture

Interaction between a DSS and the user is termed "dialog." This implies a continuous but unstructured sequence of real time user indicated controls followed by DSS displays. Thus, controls and displays are the major elements of dialog. This appendix discusses Dialog Component Architecture for a DSS, describing in summary terms how controls and displays should be perceived and exercised by the user. Four general topics are covered: formats for control; substance of displays; substance of controls (operations, procedures, and meta procedures); and controlling user access to DSS dialog.

1. Formats for Control

A simple conceptual model of the control interaction between a DSS and the user is shown in Figure B-1 below:

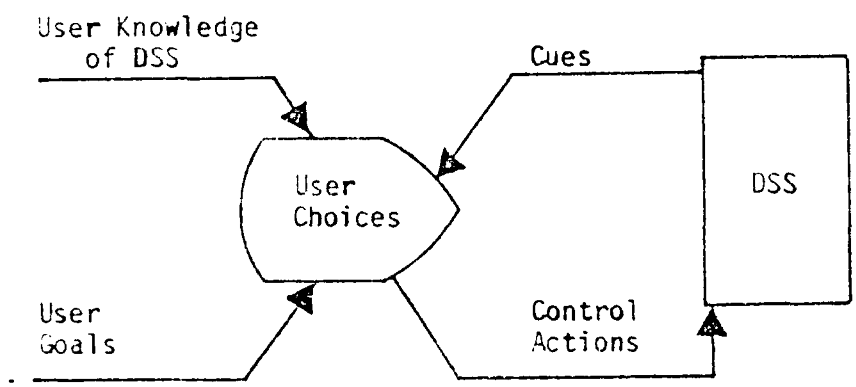


Figure B-1. Control Interaction

feature for a DSS to offer, it is the essential feature that the DSS must offer in order to live up to its name.

The modeling component of a DSS is where hierarchic systems can be addressed. The modeling component will give the user more or less capability to build and use hierarchic systems. The data base component provides the means to store information about hierarchies, but the modeling component provides the essential means to aggregate the information upward through the hierarchy, to evaluate and discriminate among different parts of the hierarchy, and to perform various analyses of the overall system.

For the foregoing reasons, we recommend an architecture for a DSS that provides models to users primarily as hierarchic systems that can be used to clarify complex program issues. The following subsections provide further details on how the user will perceive the models and use them, based on this recommendation.

3. State Models and Process Models

Generally, the word "model" connotes a representation of one thing by another, by means of duplication, imitation, relation, or analogy. We wish to distinguish two kinds of representation that are often found together in models of hierarchic systems. The first is a representation of something's "state," a model of what it is or was at some point. In Simon's words, the state representation describes "the world as sensed."

The process representation, as distinct from the state representation, describes "the world as acted upon." It does not describe what the state of the world is, but how the state can be changed, or how a particular state can be achieved. While state models are essential to a DSS, it is the process models that gives a DSS its "what if" and "what should" capabilities. Some examples of process models for program management include:

those various aspects to support management decision making and planning. This is, in our view, the proper purpose of models in a DSS; they do much more than just give the user a better calculator.

2. Importance of Hierarchy

It is not far from the mark to say that the essential, distinguishing role of the user is to manage complexity; the program management task is necessitated by the complexity of the program. Thousands and perhaps tens of thousands of low-level program decisions must be orchestrated to achieve the overall program goals. We believe, therefore, that a DSS will be a success to the extent that it aids the user to deal with complexity, especially to review and manage program decisions in a context where any one decision may impact many aspects of the program.

As explained very well by Herbert Simon in his classic paper on "The Architecture of Complexity" (1962), the basic intellectual tool for coping with complexity is the hierarchic system. By a hierarchic system, or hierarchy, he means "a system that is composed of interrelated subsystems, each of the latter being, in turn, hierarchic in structure until we reach some lowest level of subsystem" (p. 468). Hence in program management, we have activity networks, work breakdown structures, interrelated objectives networks, and baseline cost estimates (see Kerzner, 1979). The use of hierarchic systems such as these, both quantitative and qualitative, descriptive and prescriptive, is intrinsic to program management because hierarchy is the way we naturally try to cope with complexity.

If a DSS must help the user to deal with complexity, and if hierarchy is the way to deal with complexity, then it follows that a DSS must help the user to use hierarchic systems. The way we see it, help with hierarchic systems is not merely a nice

1. Purpose of Models in a DSS

There are some who might think that putting models into a DSS is analogous to giving a better calculator to an engineer, one for instance that will perform regression analysis, calculate the present value of annuities, and is programmable. Regression analysis and present value analysis are, after all, valuable models that an engineer might want to use once in a while, and they might be valuable capabilities that are general rather than focused on any particular work the engineer has in progress. They are models he actually uses in his work, not design models of his work. We believe the DSS's models will be most valuable to the user if they are models of the program itself, i.e., models that are ready to answer a large variety of "what if" questions because they are always connected to the program.

In the aircraft industry, for instance, models are used extensively for advanced design and systems development work. Wind tunnel models with extensive instrumentation are used to test and refine the physical shape of the aircraft. "Iron bird" models are used to develop the flight control actuators, sensors, and computer. Cockpit models are used to perfect the physical layout of the pilot's controls and displays. "Electronic bird" models help refine the total avionics package into a single integrated system. Finally, moving and stationary base simulators let pilots "fly" the aircraft to test the integrated behavior of airframe, flight controls, and avionics under controlled workload/task conditions.

In each case, the model accurately represents one or more aspects of the aircraft, and it provides a tool for developers to test and refine their designs. This is analogous to our concept for a useful and usable modeling component in DSS. We envision a DSS as a system with many interrelated models of the program(s) the user is managing. Individual models represent different aspects of the one program and provide the tools for "simulating"

meta-procedure or not. This helps assure that the user can correct, with full DSS support during the procedure, any inappropriate changes to data that are due to the DSS's execution of the procedure. Thus users may be able to work with a flawed procedure to get the results they want.

4. Access Management

Several people, perhaps managing several programs, can use one DSS system. Each user, as a rule, will need only a subset of the DSS's capabilities. Likewise, each user will have authority to see or to change only a portion of the program data. In this circumstance, it is important to provide a means for managing their access to the DSS's capabilities and to program data. We believe that the dialog architecture can provide the mechanism for managing users' access to DSS and its data. A "user profile" for each user would be tailored to determine which few of all DSS's control actions could be exercised by the user. This profile would be automatically applied by the DSS to mask (eliminate) many menu choices, operations and procedures from the user's view. Each user will see an individually tailored version of the DSS. This scheme readily manages DSS capabilities by tailoring menus (e.g., so that the logistics manager does not have an option to change the acquisition strategy). Thus, by including a menu that lists the programs or program phases, access to program data can be controlled.

B. Model Architecture

This section discusses an architecture for the DSS's models. It describes in summary terms how the models should be perceived and exercised by the user. Topics covered include the basic purpose of DSS's models, the importance of hierarchy, the distinction between state and process models, and generic conventions for modeling.

other inputs are required, and prompts the user for these inputs. For instance, a procedure might prompt the user for the resource available at a particular office. Another procedure might "walk" the user through all the resources allocated to the recruiting structure to support the user's planning for a budget cut. In each case, the procedure involves one representation, but changes the content of the representation.

- Meta-control. Any control that determines which representation is displayed to the user is called a meta-control. Such a control may be exercised through a simple menu selection of the desired representation. It may also be exercised through a "meta-procedure" that automatically switches the user between representations, chooses the content of the representations, and prompts the user for control actions.

The purpose of procedures and meta-procedures is to make a DSS more usable and useful. Usability is enhanced by removing from the user the burden of remembering and exercising certain often-used sequences of controls. Usefulness is enhanced by algorithms that automatically direct the user's attention to important information (e.g., to work elements that require the most resources). Although procedures and meta-procedures can be valuable, there is a danger that they will reduce rather than increase the system's usefulness and usability. Any procedure assumes a sequence of action that the user should follow. The user is forced to follow this sequence. The danger is that the procedure will not suit the needs of the user, or even run counter to those needs. Then it is a burden rather than a help.

Certain architectural guidelines will assume that a DSS's procedures become helps rather than burdens, namely, any changes that the user can make to program data, within the context of procedures and meta-procedures, should also be achievable through operations (this provides a fallback alternative for managing the program data) and all the operations associated with a representation should be available to the user whenever the representation is displayed, whether during a procedure/

can enter the name of the region at the appropriate place. The system would look for all instances of recruiting stations in that location.

- o Most report generation will be done in preformatted fashion to replicate DSS displays of the program. The user will not reformat information for these reports.

- o Data will not be brought to models (in the user's perception), rather models will be brought to those parts of the program that are in view. For instance, while viewing a recruiting area with all its information, the user may point at two of the data fields and ask for a correlation of the two across all recruiting areas. This is a much different experience for the user than a system in which the user first picks "correlation" from a menu, then "recruiting area" from the next menu, and so forth. All implications of the programmatic approach should be identified during system analysis and design.

3. The Substance of Control

Representations are displayed to the user; operations can be invoked by the user. The mechanisms for changing representations, executing operations, and using memory aids all go under the name "control." They are the substance of control, in distinction to the formats for control previously discussed.

From the user's viewpoint, we define three kinds of control substance and certain guidelines for their user. The three kinds are called operations, procedures, and meta-controls. They are defined within the context of one or more representations.

- o **Operation.** An operation changes the specific content of a representation (e.g., by editing a data element or by scrolling), and it is invoked with one voluntary control action by the user (e.g., by entering data to the screen, by pressing a function key, or by changing a control vector).

- o **Procedure.** Like the operation, the procedure changes the specific contents of one representation, and it is invoked with one voluntary control action by the user. However, unlike the operation, the procedure requires one or more other inputs from the user for its completion. The system decides which

	States Model Explicitly	C	B	A
Language for Directing Computation	Invokes Model by Name	F	E	D
	States Problem	I	H	G
		States Problem	Invokes Report	States Retrieval Procedure Explicitly

Language for Directing Data Retrieval

Figure B-2. Classification Scheme

Bonczek, et al. (1980) describes this distinction between abstract and decision/problem-specific approaches via the classification scheme shown in Figure B-2 (reproduced from their paper).

- "The horizontal axis represents the range of data retrieval languages. The range of languages for directing computations is represented by the vertical axis. The two axes meet where the distinction (in terms of appearance) between the two types of languages vanishes. This is the point where the user states the problem to be solved in terms of the data desired (the decision/problem-specific approach).

- For explanation ease, the quadrant of Figure B-2 has been partitioned into nine sections. The nature of systems in each of these nine categories will be described. The lines separating these categories are somewhat fuzzy; also, there can be fairly large differences among systems within a category.

- Thus, Figure B-2 is a descriptive categorization suggesting possible ways in which the two primary uses of computers (data handling and computations) can be incorporated into a single system for the purpose of supporting decision activities. Most systems discussed in the literature are not described in sufficient detail to allow any more than a rough plot on the diagram of Figure B-2. Systems reviewed earlier fall around the fringes of a central category."

This central category (E) corresponds to the abstract approach. We propose an architecture in which the programmatic approach is predominant. The abstract approach will be used mostly for ad hoc analytical and word processing/graphics capabilities that are not tied to specific functional areas. The following examples are typical implications of this architectural choice.

- "Indexed Topical Notebooks" will be used in preference to simple scratch pads. Such a notebook has a topic (e.g., recruiters), a table of contents, and is "loose leaf." The scratch pad has no topic and no index.

- Query will be "by example" rather than by a general query language. For instance, to find all recruiting stations associated with a region, the user will be shown the generic display for a recruiting station to which he/she

2. The Substance of Displays

There are two possible output approaches to a DSS that need differentiation. The two may be called, for lack of better terms, "abstract" and "decision/problem-specific." They will be most evident in the displays and reports generated by the DSS.

The abstract approach provides the user with general capabilities for decision support. For instance, a "scratch pad" memory for electronic notekeeping is a general capability. So are data base query, regression analysis, and report generation. The mark of the pure abstract approach is that the display representations and operations focus the user's attention on the mechanisms that can be used for decision support. That is, the user is provided tools with which he can fashion his own decision support.

In contrast, the decision/problem-specific approach is marked by display representations and operations that focus the user's attention on the program. They are designed to show the program from multiple perspectives, to change the program, to ask standardized specific questions about the program, or to evaluate the program. The display looks like an organizational structure, a schedule, a budget, a set of goals, an accession plan, or a recruiting area; all filled in with the specific program information and accompanied by standardized evaluative information.

In terms of usability, the decision/problem-specific approach is one step closer to the needs of the user than the abstract approach. The latter puts the burden on the user to turn the abstract tools into specific solutions. This work has already been done for the user in the decision/problem-specific approach, so that the user perceives himself or herself interacting directly with the decision/problem being analyzed, rather than indirectly via the abstract tools.

player. Each role is supported by a different feedback/control format.

- The User as Shopper. Here the user selects one or more options from a menu and receives no explicit feedback from the system as it proceeds to the next menu option. Implicit feedback occurs, usually when the system changes the display (e.g., presents a lower-level menu) as it carries out the options selected by the user. Command (function key) driven controls in which the commands are displayed for the user are considered menu-driven systems.

- The User as Artist. Here the user perceives a list (menu) of control items that can be changed, as well as the current values of the items. The user selects any item on the list, changes it, and receives explicit feedback that it has been changed by seeing the list re-displayed with the new value of the item. For this form of control, each item on the list is considered an independent variable. Thus there are no constraints on the combinations of values that the items on the list can take on; and no change in the value of one item affects the value of any other item. Note, this option is analogous to full screen data entry/editing.

- The User as Game Player. Here the user perceives a display that includes options that can be selected (or commanded) by the user and values of various items, only some of which can be changed directly by the user. For this form of control, all items in the display are considered interactive and dynamic. Any change or selection by the user can affect one or all of the other values or even the identity of options that can be selected. So the user makes a selection from the control options that are available, and waits while the DSS adjusts the options and values that now pertain. By iteratively choosing and receiving the feedback concerning the implications of the choice, the user can specify complex controls rapidly. This user role is characterized by a large amount of feedback.

The three formats have been defined in terms that are as free as possible from descriptions of the mechanisms of control and display. They refer to the way the user should perceive the control and feedback constructs of the system, some giving more feedback than others, as independent of the means by which they are achieved.

The purpose of displaying all of the items and changes is to provide the user adequate cues to achieve the goal (reduce the budget) via control actions.

Various combinations of command-driven, simple menu, and conditional control can be combined with additional cues related to goals. Menus and control variables can appear in the context of the additional cues. Indeed, an infinite variety of combinations seems possible.

It is not very practical to precisely tailor control actions and cues for every individual user and goal, nor to provide a system in which these can be precisely tailored by the individual user. What is practical is to predetermine one or more generic methods of control spanning the range of user needs, and to use these as basic building blocks for the design and development of control. Within their generic parameters, they can be tailored to support specific user goals. This is like building a transportation system out of cars, trucks and airplanes, and then adapting these to all transportation needs (including those currently served by trains, busses and subways). As experience is gained, the generic forms can be improved and supplemented with new forms.

For a DSS we recommend a feedback/control architecture that offers control to the user in three distinct formats. The three formats span the range of control interactions described above. They can be implemented with generic Display Generation and Management (DGM) software, either with an integrated software module or with three separate modules. They do, however, span the range from mundane to state-of-the-art DGM systems.

The three formats can be explained in terms of three stereotypes of the user's role in the user-DSS interaction. The three stereotypes are the user as shopper, artist, and game

for a special kind of control action, which is to review and edit the current settings of a group of related control variables. Such an action is easily imagined as an entry to a simple menu (e.g., "SET PRINT FORMAT") which when selected results in a multi-variable display, such as:

PRINT FORMAT

1.	Lines/Page	32
2.	Page Numbering	Yes
3.	Double Spacing	No
4.	Hyphenation	Yes

ENTER INDICES OF ITEM(S) TO CHANGE

Just as the simple menu system keeps control actions visible to the user within the context in which they are selected, so these cues for conditional control keep all of the control variables and *their settings* visible to the user within the context in which they are set.

To this point, the discussion has centered on cues related to control actions themselves rather than to the user's goals and how closely they are achieved. If the user's goal is to print a report, then the cues we have discussed already will be adequate for control to achieve the goal. If the goal is to reduce a budget, and it is to be achieved by controlling (editing) the baseline costs in the budget, then additional cues are needed beyond simple information on the new baseline costs. Specifically, the budget total is needed as a cue. Additionally, we would probably want a list of all baseline costs that are candidates for decrements, because this would help us identify where to apply decrements. In this exemplary case, a control action can be taken to change one or more items (baseline cost), and the result will change at least one other item (the total) besides the item itself.

In a recent survey of 22 interactive business applications, it was found that half employed a "conditional" control structure. That is, the user's control action often consisted of setting several control variables simultaneously, and then this multi-variable control "vector" determined the system response. While a simple menu-driven system can be used to set such a control vector, one variable at a time, it does not provide suitable cues for this kind of control. The minimum set of cues needed is a list of the control variables' names and their current settings. The user can then "work" this list until the complete set is correct. A somewhat richer set of cues would display the full range of optional settings for each of the conditional control variables. The user would at once see the current settings and all options.

We can distinguish two cases of the conditional control structure described above. In the first case, the control variables are independent of each other:

- o The range of options for one variable is not affected by the setting of any variable;
- o The setting of one variable does not affect (cause, necessitate) the change of any setting of the other variables; and
- o There are no limiting constraints on combined settings of the variables.

This case can be named "simple conditional control" because of these independencies. The second case violates one or more of the independencies and can be named "complex conditional control." An example of complex conditional control would be setting the output control variability to print, and losing the color option within the color vs. black/white control variable on a system that does not have a color printer but does have a color monitor.

Both cases of conditional control can be considered as extensions of the simple menu-driven architecture. They provide

From this figure we see that the user has certain goals to achieve and knowledge of how to use the DSS; goals are achieved through control actions; and a DSS provides cues to the user that help decide which actions can achieve the goals. The word "cue" is used in the psychological sense, meaning an indication of the nature of the situation perceived and relevant to the choices that can be made.

The most primitive format for control interaction is a command-driven system that provides no explicit cues to the user either before or after a command is executed. In this case the user must know what commands are available and what they will accomplish. The user must also imply what changes the commands have made, since they are not reported explicitly by the system. In some situations the set of possible commands is small and easily understandable, and the results of executing the commands are immediately observed. In other cases (e.g., WYLBUR), the set of commands is large, difficult to understand, and can have unobserved results.

One simple cue to help the user is a list of control actions that can be taken by the user. Such a cue reduces the amount of detail the user must recall about the system's operation. "Menu-driven" systems are typically implemented as a hierarchy of menus that divide the control actions into logical subsets. Each menu either identifies a list of actions the user can take or a list of action subsets the user can choose to examine. In a menu system, the generic, explicit cues to the user are the list of actions. The user learns what changes the actions have caused only if the actions themselves are programmed to provide such feedback to the user. Such programming is <u>ad hoc</u>, tailored to the particular actions defined. The menu-driven system with its generic cues (list of actions) is a simple, powerful, and flexible control architecture. It relieves the user of the burden of remembering the details of the control actions.

- MODEL OF: Total program budget.
  =
  PROCESS: Add together the resources for all resources.

- MODEL OF: Program completion date.
  =
  PROCESS: Perform a PERT analysis of the program's activity network.

- MODEL OF: Best plan to accommodate a 10% budget cut.
  =
  PROCESS: Perform a Critical Path Method (CPM) analysis to reallocate reduced resources to minimize schedule impact.

These are not at all exhaustive, but they do show how certain aspects of the program can be modeled as processes. It should also be clear that the processes must rely on state models for their basic information. That is, the current status of the program is essential 'input' to the processes.

In general, a model of a hierarchic system will include both state representations and process representations. At the lowest level of the hierarchy, the information on actual expenditures will constitute state representations. At higher levels, the aggregate expenditures will be represented by aggregation processes. If implemented as a spreadsheet program, the information at the lower levels will be determined by user-input status data, while the information at the upper levels will be determined by user-input equations. That is the normal order; however, some spreadsheet programs provide for reverse order models as well, so that the user can change the value at the top and see the implications for lower levels.

The user's perception of state models is likely to be very direct, for they constitute the structure of the hierarchy and the status of its lower components. The user's perception of process models, however, is likely to be indirect, much as the person using a completed spreadsheet model sees only data

representing his problem, not the equations that generate the data.

4. Generic Conventions for Modeling

The previous discussion of models makes several points about a DSS's requirements for modeling. Among these are:

- o DSS models will generally be hierarchic, representing systems of subsystems of subsystems, and so forth; and

- o DSS models will generally incorporate both state descriptions and process descriptions of the program(s). To achieve these requirements, we propose several generic conventions for modeling. These do not presume any specific hardware/software design. Consistent with the foregoing discussion of models, the conventions are those that would be apparent to users of the models.

a. The Elements of Models

Any one view of the program will correspond to a hierarchic system model with both state and process representations of the program. The elements of the model will be as follows:

- o A set of one or more kinds of generic "blocks" for modeling;

- o A defined hierarchic structure of specific blocks from the generic set;

- o For each specific block a set of equations/algorithms that calculate one or more of the attributes in the block from the values of attributes in other blocks and this block without user control and a set of "constant" values for certain attributes in the block that are subject to direct change by the user but not by automatic computations; and

- o A set of process models, defined in terms of procedures applied to the hierarchy of blocks, that determine overall features of the hierarchy. Some of these can be executed automatically without user control, so that their results are always visible.

Others will be executed in response to control actions by the user.

b. The Integration of Models

The models in a DSS will provide different views of the same program. This implies a high degree of integration among the models. Changes to the program must be seen approximately in each view.

To assure that DSS models are easily and flexibly integrated, the values of all attributes of all blocks of all models may be used by the equation algorithms in any specific block of any model to calculate attributes for that block. In particular, this convention will assure that DSS's models can support the mathematical architecture.

While the convention provides for highly integrated models, it must be applied wisely by modelers (DSS builders and users). The burden is on them to assure that their models are internally consistent. Some of this burden can be taken by special software tools that help them validate their models.

c. Model Management Conventions

The designers of a DSS will develop several hierarchic models by specifying the kinds of generic blocks, the equations within each block, generic equations between blocks, and overall process models. The users will have the capability to develop specific hierarchic models with the blocks, in accordance with specific conventions determined for combining blocks in each model.

Besides the hierarchic models provided by DSS's designers, we believe a DSS should also provide users a capability to design their own hierarchic models from

scratch, integrated through the attributes with all other hierarchic models. We believe that a simple menu of equations can be offered to the user for defining the equations relating the attributes within and between blocks. We do not envision, however, a DSS in which users design their own process models or specialized dialog for their models. Process models and dialog are inherently algorithmic rather than structural, and should be left to specialists to program for the forseeable future.

UNITED STATES ARMED SERVICES AND OFFICE
FOR THE SECRETARY OF DEFENSE

ENLISTMENT EARLY WARNING SYSTEM AND ACCESSION CRISIS PREVENTION PROCESS

VOLUME VI ACCESSION CRISIS PREVENTION PROCESS

JUNE 15, 1984

ECONOMIC RESEARCH LABORATORY INC.

Advanced Technology

SRA CORPORATION

ACCESSION CRISIS PREVENTION PROCESS

Systems Research and Applications Corporation

Arlington, Virginia

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CHAPTER I
INTRODUCTION

A. Objective

The objective of the Accession Crisis Prevention Process (ACPP) is the same as that of the Enlistment Early Warning System (EEWS): to help the Military Services meet the quantity and quality requirements for military accessions in spite of changing recruiting conditions.

B. Purpose

The Accession Crisis Prevention Process is intended to improve the responsiveness of the Department of Defense and higher levels of government to needs for changes in resources and policies to avoid accession crises. Experience has demonstrated time and again that the current resource allocation process lags requirements by about 2 years. A more responsive process is needed to meet changing labor market conditions and avoid either spending more on recruiting than is necessary or facing shortfalls in the quantity or quality of accessions.

The purpose of this phase of the study is to develop the concepts and test the feasibility of an EEWS-ACPP system. A second phase of the study is planned to develop the details of the proposal and prepare and test prototypes of the various components of the EEWS-ACPP system.

C. Context

This volume of the Enlistment Early Warning System and Accession Crisis Prevention Process report focuses on the second aspect, the ACPP: how to take advantage of a warning when one is issued. ACPP is integral to the concepts developed in the previous volumes. As shown in the conceptual overview illustrated in Figure 1-1, the early warning system concept calls for a computer-assisted alert phase and a formal human assessment phase.

In the monitor and alert phase, information on leads, applicants, contracts, and accessions (and other relevant information available to the Military Services) together with non-DoD information such as unemployment, will be monitored on a regular basis through a computer-assisted program. This program will predict the number of contracts with high quality potential recruits and compare forecasts over the next several months with requirements. Whenever the program forecasts a significant deviation from requirements, the system will sound an alert.

As shown on Figure I-2, the alert information is fed automatically to the accession staff in the Office of the Secretary of Defense and the Military Services. Each of the four Military Services will assess individually what the alert means to them, and the OSD staff will make a DoD-wide assessment. Representatives of each of these five staffs are to meet as the Human Assessment Group to validate the alert and to decide whether or not to issue a formal warning.

A warning simply means that the alert is valid, the recruiting program is not in balance, and recruiting conditions no longer match those assumed when the current budget for recruiting resources was developed. A warning is what activates the Acccession Crisis Prevention Process.

EEWS AND ACPP PROCESS

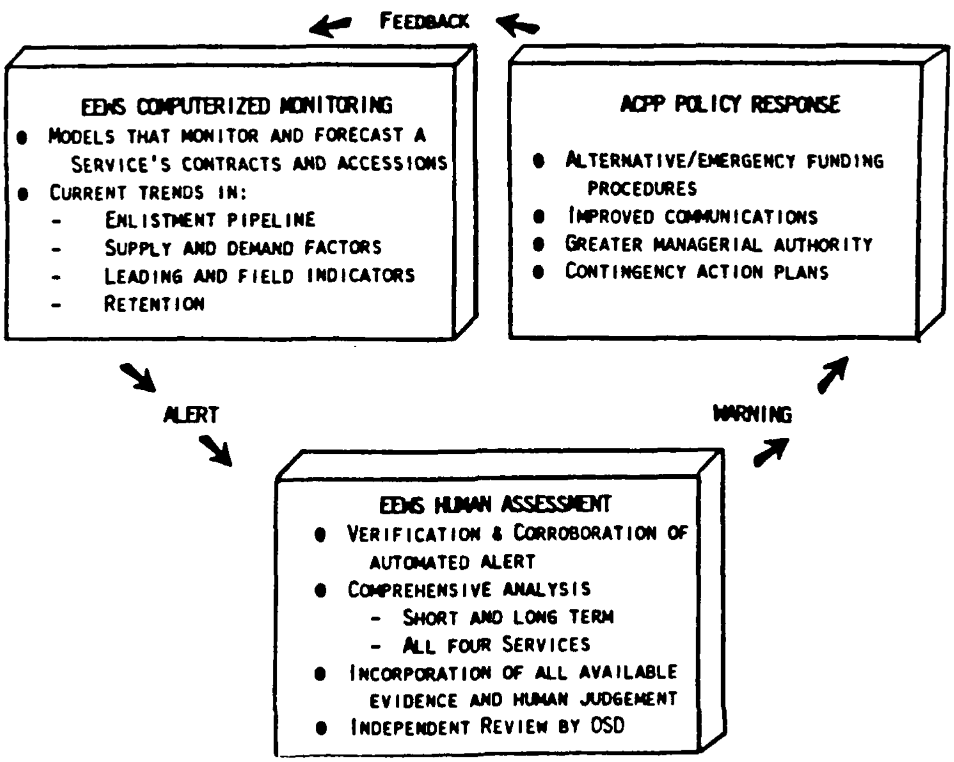

FIGURE I-1

EARLY WARNING SYSTEM

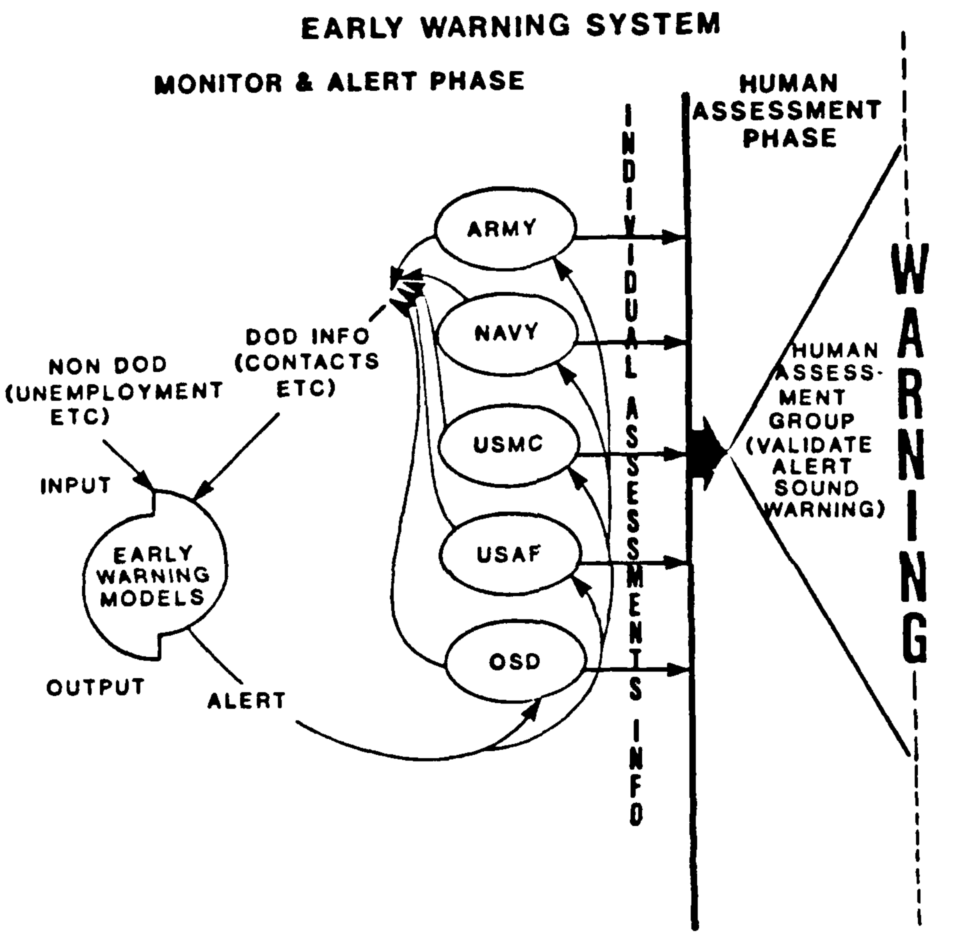

FIGURE I-2

A strawman ACPP was developed early in the research effort to demonstrate various ideas and to provide a tangible concept for discussion. That strawman has been altered and changed during the research effort and now is composed of the following five parts:

1. Regular Manpower Secretarial Performance Reviews (SPRs);
2. Improvements in DoD's Planning, Programming, and Budgeting System and in the Congressional Authorization and Appropriation Processes (PPBSAA);
3. Improvements in Interlevel Communications;
4. A new Offline Adjustment Process (OAP); and
5. A new Immediate Crisis Avoidance Authority (ICAA).

This five-part proposal will be discussed in detail in the subsequent chapters, using the following approach.

D. Approach

The analytical approach used in developing the ACPP was straightforward. First, determine why past accession crises occurred. Second, look for ways to avoid making those same mistakes in the future. Third, develop systemic improvements in management procedures and processes to institutionalize these crisis prevention concepts. Fourth, refine the improvements through iterative discussions with those who must make the system work. Finally, test the feasibility of implementing the proposed changes.

The feasibility test examines each proposed change to see if there are any restrictions that would preclude making such an adjustment and then evaluates the likely effects of the adjustment to see if it produces side effects that would make it inadvisable. The improvements were discussed with a

experience of the late 1970s indicates that more than 36 months elapsed between problem recognition in the field in 1977 and increases in field recruiters that occurred in 1980. The large increase in recruiting resources did not take effect until 1981. During this period there were two Congressional elections, a Presidential election, and a change in Administration.

From this theoretical analysis, the study team concluded that the problem includes delays both in recognizing changes in recruiting conditions as they occur and in reallocating resources once the changes are recognized. The next chapter will present concepts aimed at improving the management system's ability to respond to changing recruiting conditions. First, it seems prudent to consider some actual data to substantiate the theory presented here.

E. *Historical Confirmation*

In spite of changing recruiting conditions, the Military Services ended each year close to their authorized active duty end strengths (total number of military personnel authorized). Total strength is the ultimate measure of the system because it accounts for changes in requirements as well as changes in both the supply and the demand for accessions. Using end-strength criteria, the system was judged to be successful until the late 1970s when all four Services began to have problems meeting their end-strength targets.

Although end-strength is the ultimate measure, when studying recruiting success, comparing actual accessions with accession objectives is the more common measure. Table II-1 shows recruiting success by Service for the 10-year period

At the White House - Executive Office level, recruiting problems are weighed in the context of all of the problems facing the nation. Politics is an every day fact of life that is (and ought to be) part of most decisions. Over the past 15 years, the method used to draft or recruit young people for the military and the success of the all-volunteer force have been important political issues.

The Ofice of Management and Budget (OMB), acting for the President, must screen special requests for recruiting against all of the other demands that the President's program is making on the Congress. Often the OMB response is, "You Defense people are about to work a new POM (or budget), why don't you crank this special request into that process; and we will consider it a part of next year's proposal."

Having OMB and White House support is essential when dealing with a budget item that has the "special Congressional interest" that recruiting has experienced in the past decade or more. Unless the management system specifically calls for such special attention or directs actions to be taken because of the circumstances that have occurred, experience indicates that executive level support can take considerable time, even when the need is well documented and the Administration is sympathetic.

When one must go all the way to the top of the pyramid to obtain Congressional approval, the process can be slow and cumbersome. Research on this subject is not yet complete, but preliminary indications are that at least 18 months are needed to go from initial field recognition to the Congress and back. Delays of this magnitude have occurred even when using some Congressional short cuts and back doors. The

levels the military tradition of saying, "Yes, sir," and trying harder keeps the accession flow up until there is no reserve elasticity left. Therefore, when higher levels perceive a problem, often there is little flexibility left to hold the line until additional resources can be made available.

Moving to the Office of the Secretary of Defense (OSD) level introduces multiservice complexities. Not only must recruiting resource decisions include the effect on the Service being considered, but the expected effects on the other Services must be weighed. A 1974 OSD study ("The Effects of Advertising on LeadGeneration and Recruiting Costs") warned that interservice competition for a limited number of high quality recruits may bid up advertising costs. The joint advertising program, managed by OSD in cooperation with the Services, was developed to reduce the propensity for internal price escalation.

At the OSD level, many other demands compete for management attention with recruiting. A recruiting problem that seems to have many months' lead time before it will result in acccession shortfalls often is deferred in favor of the more pressing problems of the day. As one rises in the pyramid, political considerations become increasingly important and often cause delays that at the lower level seem to be inordinately long for relatively simple proposals.

The problems of masking become even more serious. Often the higher levels are making decisions on the basis of outdated information. Recognition and communication problems become increasingly difficult and time-consuming as one rises in the pyramid.

The recruiting commander works closely with the field structure and soon becomes aware of general trends. The recruiting commander has some management flexibility. He or she can adjust resources, set or change policies, and take some actions to increase supply. However, this flexibility is limited largely to improving management, concentrating resources in problem areas, and reporting the problem to higher levels.

The effects of recruiting command actions are quickly realized in the field. Time delay is relatively small, and interaction between the recruiting command level and the recruiters is personal and often direct or through only one or two levels of authority.

The Service level is the first level that has the ability to increase total resources committed to recruiting. It also is the level that can take actions to reduce demand for new personnel as well as take actions to increase the supply. At this level, however, other pressing management problems compete with recruiting for the attention of the Service leadership and the resources at their command. Because recruiting is a high interest Congressional item, the Services often do not have as much flexibility in how they manage their recruiting resources as they do with some other parts of their budgets.

Going to the Service level adds considerably to the delay in getting information both up and down the chain. Several levels of command and management are involved. Actions taken at the Service level and below often mask the recruiting problem and prevent higher levels from realizing promptly the seriousness of specific recruiting problems, or improved conditions when that occurs. Often at these lower

DECISION PYRAMID

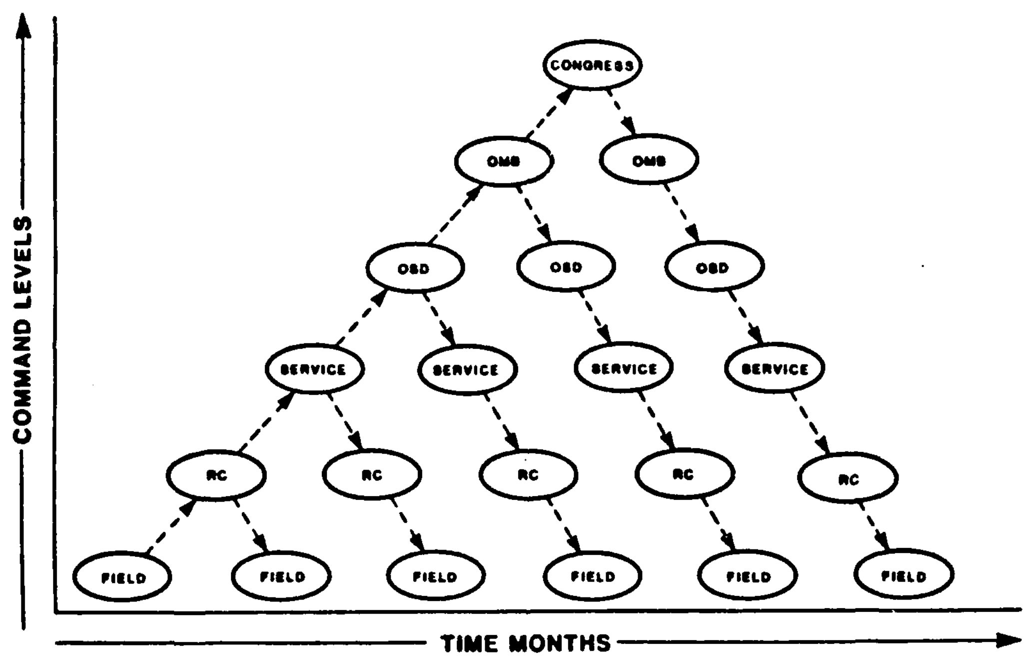

FIGURE II-3

The current flexibility would be of only limited use if recruiting conditions deteriorated substantially for all Services at the same time.

The proposed ACPP is intended to build on the current increased flexibility by providing a system that can respond to rapidly changing conditions for all Services simultaneously. If actual conditions deviate substantially from those assumed during budget development, this additional flexibility would be very important.

D. The Decision Pyramid

To help understand the delays associated with recognition and resource allocation, it is useful to consider the decision pyramid in Figure II-3. The bottom level of the pyramid represents the Military Services' recruiting field structure. Field recruiters contact the public and attempt to recruit young men and women for their particular Services. This level initiates much of the reporting of conditions and often must receive tangible resources to make significant changes in their recruiting success.

The lower left-hand corner represents the field's own efforts. The field recruiter recognizes the changes in recruiting conditions in his area almost immediately. For some reason, he or she is not making quota this month. Recruiting is more difficult. Usually the recruiters assume that this is their own fault and try to compensate by working harder, monitoring their delayed enter program personnel closely to reduce attrition, and working more intensely in the more productive locations in their assigned areas. At this level, recognition of the problem and action taken are almost immediate. Except for increased personnel effort, the recruiter's primary access to help is from the recruiting command.

These recognition lags and resource delays are an inevitable part of the Federal Government's PPBS and appropriation processes and cannot be fixed directly. The PPBS and appropriation cycle likely will continue to require a 24-month cycle. The ACPP effort seeks indirect solutions that accelerate recognition of changing conditions and facilitate near-term resource adjustments.

The EEWS discussed in previous volumes is an effort to help accelerate recognition of changing recruiting conditions, but it is not sufficient in itself. The management system also needs to make improvements in its internal communications so that higher levels in the Administration are aware of changing conditions as they occur and do not make decisions on the basis of information and assumptions that are no longer valid.

The resource delay problem seems to call for a method of adjusting near-term resources to meet changing conditions, to give the program managers more flexibility in how to spend their recruiting resources when conditions that underlie their recruiting budgets change. The Department of Defense has considerably more management flexibility now than it had in the 1970s. Congressional ceilings and restrictions on recruiting now generally apply to DoD as a whole whereas they used to be imposed on each Service. As a result, in 1984 reprogramming among Army, Navy, and Marine Corps overcame problems that previously would have required Congressional approval.

This example illustrates the value of the ACPP concepts, but does not imply that the problems have been solved. Current flexibility only works when the overall recruiting program has about the right resources; but internal redistribution is needed still.

Meanwhile, conditions continued to deteriorate in the second year, calling for increased resources that take affect well after they were needed. The improved conditions in year three lead to a reduction in recruiting resources that take affect just when conditions begin to turn down. The outstanding conditions in year four result in resource cuts that come to fruition during the nadir of the next indicator cycle, just when the recruiting market is about to come down with a bearish crash.

The accession goal is still 100% of the number and quality of accessions required. In reality, however, the current system often has not met that goal. In some years, the goal has been exceeded; and in many others it has not been met. The deviation usually has been in quality rather than quantity, as shown by the actual data presented later in this section.

As discussed above, often the reason that recruiting has not met accession goals is a lag between the time when recruiting conditions change and the remedies are applied. This lag is composed of two parts: (1) Recognition Lag - the lag between when recruiting conditions change and the decison-makers recognize the change; and (2) Resource Delay - the delay in PPBS and appropriation processes that actually change the resource levels.

The dilemma shown in Figure II-2 is that, in spite of the best management efforts of all concerned, the recognition lags and resource delays result in resource changes that are in phase with the recruiting conditions instead of out of phase as the theory suggested. When recruiting conditions are good, there is an abundance of resources. When recruiting conditions are bad, there is a scarcity of resources.

RESOURCES LAG INDICATORS AND CAUSE WASTED RESOURCES & ACCESSION PROBLEMS

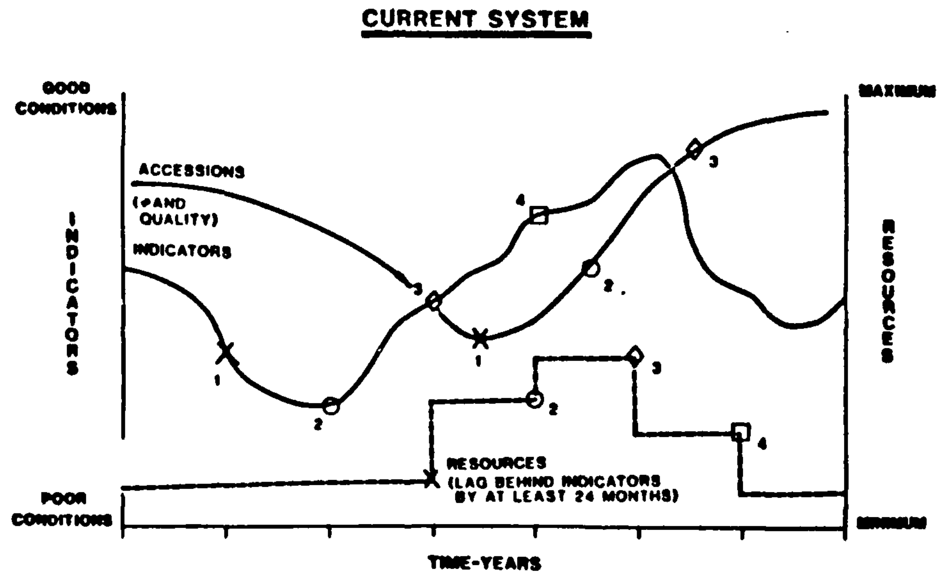

FIGURE II-2

The problem is that conditions do not change in such a regular fashion, as the stylized current system shown in Figure II-2 demonstrates.

C. <u>The Current System</u>

Both the axes and the things measured on Figure II-2 are the same as on Figure II-1. The indicators of recruiting conditions (labelled indicators on Figure II-2) are not a smooth sine curve. It tends to be cyclical, but does not vary in a regular and predictable cycle. There are false indicators or short-term variations on the cycle, and the magnitude of the peaks and valleys varies considerably. This erratic behavior of recruiting conditions complicates the process of setting resources many months in advance.

The symbols and numbers on Figure II-2 illustrate this difficulty. For each line, the "X" with the "1" beside it indicates events determined in year one; the circle with the "2", events determined in the second year; the diamond with the "3", the third year; and the square with the "4", the fourth year.

Conditions observed in the first year are shown by the "X 1" on the indicator curve in Figure II-2. Because of the indication of declining conditions, the POM and budget process increase recruiting resources substantially, but the nature of the Defense Planning, Programming, and Budgeting System (PPBS) is such that those resource changes do not take effect until about 24 months after the observations are made. The lag in effectiveness means that the change in resources does not take full affect for another 6 months when, given our example, conditions have improved considerably.

vary rather dramatically from year-to-year depending on changes in force structure, expected losses, and reenlistment performance. The accession programs of the Services need to be adjusted to meet their annual requirements. Here, however, it is sufficient to represent accession goals and achievement of those goals by the 100% line.

Recruiting conditions change over time because of changes in the economy, the level of military pay relative to civilian pay, employment and training options available to youth in the civil sector, the size of the military eligible pool, youth attitudes about military service, and other factors. Work reported in previous volumes indicates that unemployment changes are the most significant of these variables, but all have their effect on recruiting conditions. Changes in these variables can change recruiting conditions substantially in the period between when recruiting budgets are developed and when the resulting resources are used to enlist young men and women.

The EEWS discussd in volumes II and IV of this report measures indicators of recruiting conditions (e.g., forecasts of unemployment, leading economic indicators, etc.) that can be compared to the indicators assumed in setting the current recruiting resource levels. The sine curve on Figure II-1 illustrates changing recruiting conditions over time.

The cosine curve on Figure II-1 represents recruiting resource expenditures over time. The objective is to adjust resources to match conditions in order to maintain a steady flow of high quality accessions at a minimum cost. If conditions varied in a regular and predictable manner such as the sine curve indicates, adjusting resources would be the relatively easy task of time-phasing resource changes as the cosine curve would indicate.

ACCESSION INDICATORS AND RESOURCES

IDEAL CONCEPT

- RESOURCES INCREASE AS CONDITIONS WORSEN
- RESOURCES DECLINE AS CONDITIONS IMPROVE

RESULT: A STEADY FLOW OF ACCESSIONS AT MINIMUM COST

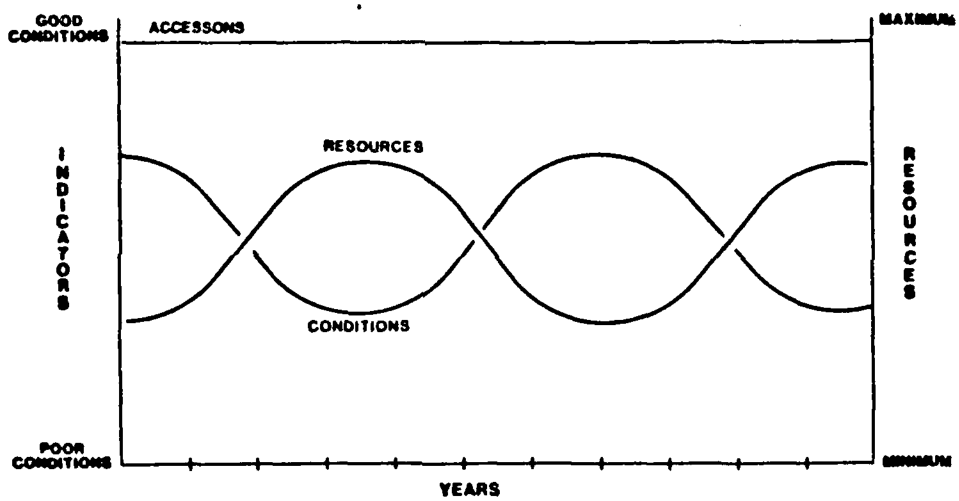

FIGURE II-1

CHAPTER II

THE PROBLEM

A. Chapter Overivew

This chapter examines the problem of accession crisis. In considering the circumstances that potentially could lead to accession crises, it first discusses the basic concepts and fundamental relationships among accessions, recruiting conditions, and recruiting resources in an idealized or theoretical framework. Then, reality is weighed against that framework to discover how the current system deviates from the ideal. The concept of a decision pyramid is used as a model to demonstrate recognition lag, resource reallocation delays, and interlevel communications problems. A historical review of the problems during the accession crisis of the late 1970s and of recent events confirms the need for an Enlistment Early Warning System (EEWS) and an Accesion Crisis Prevention Process (ACPP).

B. Ideal Concept

Figure II-1 illustrates an ideal concept for managing recruiting resources and incentives. The horizontal axis is measured in years. The vertical axis has three scales. The first is the percent of quality accessions recruited, the second is the indicators of recruiting conditions, and the third is recruiting resources. All three factors increase going up the vertical axis.

In this idealized presentation, accessions are shown at a level of 100% to represent the objective stated in Chapter I of meeting quantity and quality accession requirements of the Military Services. Actual numerical accession objectives

wide range of participants, both those with recruiting responsibilities and those with resource allocation responsibilities. When problems were raised, efforts were made to solve them in a manner that would be satisfactory to all concerned.

At the end of this process, a consensus was developed that the problems are real and that the proposed concepts, if they worked as planned, would make substantial improvements. There was not universal agreement that systemic change was necessary nor that the Congress would concur in preagreements, banking of resources, and the offline adjustment process. The report ends with the tentative conclusion that the concepts are feasible, but that feasibility assessment should continue through the prototype development and simulation evaluation stages of phase II.

This report ends with feasible concepts. The second phase of the study will help the participating Services and the Office of the Secretary of Defense develop the concepts into specific operating prototypes and test them as if they were part of the planning, programming, and budgeting system.

E. Organization

The remainder of this volume is organized as follows: Chapter II discusses the problem, first in theoretical terms and then with specific examples; Chapter III presents the basic concepts for the Accession Crisis Prevention Process that were developed as a result of applying the approach discussed above; Chapter IV assesses the feasibility of implementing the concepts, and Chapter V draws tentative conclusions from this stage of the study and lays out the next steps.

Recruiting Success
(Accessions in Thousands)

Fiscal Year	Army Obj	Army ach	Army %	Navy Obj	Navy ach	Navy %	USMC Obj	USMC ach	USMC %	USAF Obj	USAF ach	USAF %
1975	205	209	102	109	110	101	59	60	102	75	77	103
1976	191	192	101	104	104	100	53	53	100	73	74	101
1977	182	181	99	114	110	96	49	47	96	74	74	100
1978	137	134	98	93	87	94	41	41	100	69	69	100
1979	159	142	89	92	86	93	43	42	98	69	68	99
1980	170	173	102	98	98	100	44	44	100	75	75	100
1981	137	130	101	102	104	102	43	44	103	81	81	100
1982	125	130	104	93	93	100	41	42	103	74	74	100
1983	144	145	100	83	83	100	38	39	103	64	64	100

TABLE II-1

from 1974 through 1983 (source: Hunter and Nelson, "Eight Years with the All Volunteer Armd Forces," Military Service in the United States, ed. by Brent Scowcroft, 1982, with updated data from the Defense Manpower Data Center). Three columns are shown for each Service: the accession objectives and actual accessions in thousands of recruits and accessions as a percentage of objective. In 1974, 1977, 1978, and 1979, the Army accessions fell short of objective. The most serious shortfall was 17,000 accessions (11% of objective) in 1979. Navy fell short in 1977, 1978, and 1979 by 4%, 6%, and 7% respectively. The Marine Corps fell short in 1977 and 1979, and perhaps made its objective in 1978 only because it was the lowest Marine Corps recruiting objective in the 10-year period. Even the Air Force missed its accession objective in 1979. In spite of significantly reduced accession demand by all Services (shown by the smaller objectives) these data indicate that all Services experienced accession problems in the late 1970s; but the overall accession numbers only tell part of the problem. Quality variations were even more significant.

Table II-2 shows the quality distribution of accessions by Service from 1952 through 1983 (source: Profile of American Youth, March 1982, with updated data from the Defense Manpower Data Center). The percentage of accessions scoring in categories I through IV on the Armed Forces Qualification Test (AFQT) are shown for each Service for each year. Category I is well above average, category II is above average, category III is average, and category IV is below average. There also is a category V, well below average, but the Services are prohibited by law from recruiting category V personnel.

DISTRIBUTION OF MALE NONPRIOR SERVICE ACCESSIONS
BY ARMED FORCES QUALIFICATION TEST (AFQT)
CATEGORY AND SERVICE, FISCAL YEARS 1952-1983
(Percent)[b]

Fiscal Year	Service															
	Army				Navy				Marine Corps				Air Force			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1952	6.9	20.4	28.7	44.1	5.5	24.0	37.1	33.4	5.7	21.3	30.5	42.6	6.9	23.8	36.0	33.4
53	7.0	22.9	29.4	40.7	6.8	28.3	37.5	27.4	4.9	23.1	37.8	34.2	9.0	28.1	36.0	26.9
54	9.7	25.9	34.9	29.8	7.4	27.2	39.7	25.7	4.2	20.5	40.9	34.4	6.5	25.5	41.2	26.8
1955	9.6	26.7	35.9	27.8	4.8	21.0	38.0	36.2	6.2	27.5	46.1	20.2	6.5	25.2	41.7	26.6
56	8.4	26.5	38.6	26.5	5.7	23.6	38.4	32.3	4.4	21.7	39.0	34.9	7.5	28.9	45.4	18.2
57	8.2	24.1	37.2	30.5	6.7	26.2	50.8	16.3	5.4	23.1	45.9	25.6	8.4	27.4	49.2	15.0
58	8.5	23.2	41.7	26.6	7.7	28.5	56.6	7.2	7.4	26.9	56.7	9.0	11.3	33.1	47.9	7.7
59	8.8	24.2	46.1	20.9	8.9	32.2	50.4	6.5	6.0	25.4	58.9	9.7	12.2	33.6	43.7	10.5
1960	8.2	24.1	50.7	17.0	7.5	29.3	56.1	7.1	5.3	22.3	56.0	16.4	10.3	32.5	45.5	11.7
61	6.1	27.4	53.3	13.2	5.7	34.6	49.7	10.0	4.8	31.2	56.9	7.1	6.7	34.8	42.4	16.1
62	5.8	27.3	44.5	22.4	5.5	34.2	48.5	11.8	4.4	32.5	54.1	9.0	8.5	40.9	43.4	7.2
63	5.1	26.7	46.7	21.5	6.4	36.9	51.1	5.6	4.9	37.5	53.7	3.9	7.7	38.2	45.7	8.4
64	5.7	28.0	46.4	19.9	6.1	34.9	48.0	10.9	4.6	32.8	53.4	9.2	8.7	41.0	46.2	4.1
1965	4.8	26.7	49.3	19.2	5.3	33.0	47.9	13.8	4.4	33.7	58.1	3.8	7.7	39.1	45.7	7.4
66	5.6	28.5	42.5	23.4	8.1	42.8	43.7	5.4	5.5	33.3	47.7	13.5	8.2	41.4	44.0	6.3
67	5.9	28.5	39.3	26.3	9.8	50.8	27.8	11.6	4.7	31.2	46.7	17.4	8.0	39.9	40.1	12.0
68	5.5	27.3	39.2	28.0	8.8	51.0	23.6	16.6	3.9	26.7	47.2	22.2	7.9	39.0	36.2	17.0
69	6.1	28.3	38.1	27.5	7.0	40.7	33.1	19.2	3.5	25.5	45.3	25.7	8.2	38.5	35.5	17.8
1970	5.2	28.0	41.0	25.8	6.1	38.6	38.9	16.4	2.9	24.4	48.5	24.2	8.1	38.6	35.1	18.1
71	5.1	27.6	42.1	25.2	6.1	39.6	40.2	14.0	2.5	23.4	55.0	19.1	5.9	33.6	42.7	17.8
72	4.0	28.4	48.8	18.8	4.5	32.5	42.8	20.2	2.2	22.1	55.6	20.1	5.4	37.3	48.6	8.7
73	3.4	27.5	51.8	17.3	3.6	32.1	48.5	15.7	2.1	22.6	60.8	14.6	5.5	38.5	51.8	4.2
74	3.6	27.5	51.1	17.8	2.7	33.7	60.3	3.3	2.7	30.7	59.0	7.5	4.7	40.8	53.9	0.6
1975	4.5	30.3	55.1	10.0	2.8	35.2	57.2	4.8	3.0	33.8	59.8	3.5	3.9	40.0	55.6	0.4
76[a]	3.2	25.7	54.5	16.6	4.9	39.4	47.5	8.2	3.0	35.9	54.4	6.8	5.4	46.0	47.6	1.0
77	2.3	17.9	36.4	43.4	5.9	33.4	40.8	19.9	3.3	26.5	45.6	24.6	7.1	46.4	41.6	5.0
78	2.3	17.6	36.5	43.6	4.9	33.0	44.0	18.1	2.5	23.2	46.1	28.2	5.2	40.7	47.8	6.3
79	1.7	14.4	35.1	48.7	4.2	30.0	44.0	21.4	2.2	21.4	47.5	28.8	4.7	36.2	49.0	10.0
1980	1.5	13.7	34.7	50.1	4.5	32.6	45.3	17.6	2.3	23.4	46.5	27.8	4.1	36.2	49.9	9.9
81	2.2	21.4	44.5	30.9	3.6	35.0	49.0	12.4	2.4	30.3	54.4	12.9	3.6	39.5	49.8	7.1
82	2.9	28.3	47.0	21.8	3.6	36.1	49.2	11.2	2.1	30.9	57.8	9.2	3.3	40.3	49.8	6.6
83	3.4	32.1	50.8	13.7	4.2	40.4	46.8	8.6	2.4	33.7	57.6	6.3	4.4	44.4	48.6	2.6

a - FYs 1976-80 reflect renormed data.

b - May not sum to 100 percent due to rounding.

TABLE II-2

Initially, focus on the data on Table II-2 for years 1974 through 1980, the percentage of Category IV (below average) accessions increased dramatically, especially in the Army. These changes were recognized in the field and became the subject of Congressional concern (Representative Beard Report, 1978 and Senator Nunn Hearings 1977, 1978, and 1979). At this same time, the Office of Secretary of Defense was preparing a report to Congress stating that the All-Volunteer Force was meeting (and was forecast to continue to meet) accession requirements with high quality personnel (America's Volunteers - published December 31, 1978).

Some resource adjustments were made in 1979, but full recognition of the problem at the higher levels of the Government did not come until after the problems regarding renorming of recruit-ing tests were discoverd in 1979. The Armed Services Vocational Aptitude Battery (ASVAB) recruiting tests had not been renormed properly; and, as a result, many recruits who had been classified as average were in fact significantly below average (Profiles of American Youth, March 1982). The accession quality data shown on Table II-2 have been adjusted for the renorming error.

Table II-2 shows that high percentages of accessions testing in Category IV are not unique to the 1970s. In 1952 and 1953, over 40% of Army nonprior service (NPS) accessions were in Category IV. In 1957, Category IV accessions comprised more than 30% of Army NPS accessions and were in the high twenties during many other draft-era years. Both the highest and the lowest percentages of category IV accessions occured during the AVF. The Army's lowest percentage of category IV accessions (10%) occurred in 1975 (the peak recruiting year in the decade of the 1970s) indicating that perhaps this was a period of excessive recruiting resources, as discussed above.

The sharp increase in low quality accessions occurred 2 years later. In 1977, below average (category IV) accessions leaped from 17% to over 43% of the total NPS accessions and then continued to climb to 44% in 1978, almost 49% in 1979, and over 50% in 1980.

Although the rapid increase in percentages of category IV accessions in the late 1970s was not unique, it was considered to be a serious problem that might require a return to conscription if it persisted. With the increase in recruiting resources reaching the field in late 1980, the increased unemployment because of the depressed economy, substantial increases in military pay, and improved perceptions of the military generally, recruiting conditions improved markedly in 1981 and continued to improve through 1983. The percentages of category IV NPS accessions dropped rapidly to levels approaching the 1975 nadir.

Some of the quality problem of the late 1970s was the result of the renorming, but much of it can be attributed to lags in recognizing change in recruiting conditions and in reallocating resources once the changes were recognized. Senior officials in the Services, in the Office of the Secretary of Defense, and in the Office of Management and Budget did not perceive the seriousness of the problem that was recognized in the field and reflected in Congressional hearings. When the problem was recognized, 18 months were required before significant changes were seen in the recruiting data.

The interlevel communications and recognition lag problems appear to be more than just a phenomenon of the Carter Administration or the renorming situation. They predated both, and evidence suggests that they still exist.

Analysis of contracts and other leading indicators during the Enlistment Early Warning System work and presented in previous volumes showed that there was a significant but not devastating downturn in recruiting conditions in the first and second quarters of 1984.

During a May recruiting workshop that was part of this study, this phenomenon was discussed in some detail. The Army participants were most concerned about the downturn. The participants from the other Services indicated that they had been slower in recognizing the change and that they were less concerned that it would seriously affect them than was the Army. Participants from the Office of the Secretary of Defense (OSD) felt that they had been uninformed of the Army's concerns and had been taken by surprise when the Chief of Staff of the Army raised recruiting as a major issue in his testimony during the 1984 Congressional Oversight Hearings.

His warnings were not supported in testimony by the Assistant Secretary of Defense for Manpower, Installations, and Logistics or by the Secretary of Defense. The OSD officials testified that 1983 was the best recruiting year ever and that sustaining an all-volunteer force was no longer an issue.

The Army's concerns were not in meeting its 1984 accession and quality goals nor in enlisting high school seniors. The Army's concerns focused on the drop in the enlistment rate of upper mental group high school graduates in 1984 and the effect that would have on the carry-over delayed entry program (DEP) and consequently on its 1985 accession program.

The Services' 1985 recruiting program already were sized and submitted to Congress as part of the President's 1985 budget in January 1984. At the time of the workshop, the Services were developing their 1986 programs for submission to Congress in January 1985. The Services' current recruiting programs were operating on resource levels developed in 1982 based on observed recruiting conditions in 1981 and early 1982 and recruiting forecasts for 1984 that were made in 1982. The President's 1984 budget was submitted in January 1983 and appropriated by Congress as part of the 1984 Defense Appropriations Act. The Army participants were concerned that both the current 1984 Army recruiting program and the planned program in the President's 1985 budget were inadequate because of the recently observed changes in recruiting conditions.

The Secretary of Defense's 1985 Posture Statement and the 1985 Defense Manpower *Requirements Report demonstrate* the recognition lag. If the Army's concern was justified, then one might expect it to be a prominent issue in those documents. If the Army's concern was a false alarm, then it should have been considered in the OSD and OMB policy reviews and resolved within the decision pyramid. For the Chief of Staff of the Army to raise the issue as the Army's major manpower problem in a national forum with wide media coverage before it was recognized and accepted at the OSD and OMB levels of the pyramid demonstrates that interlevel communication problems and recognition lag are still relevant problems.

One also can make the case that recruiting resources in 1982 and 1983 were higher than may have been needed. In October 1982, the President's Military Manpower Task Force,

chaired personally by the Secretary of Defense and composed of senior White House and DoD officials, reported that ".... 1982 has been the best year of recruiting and retention that the All-Volunteer Force ever experienced." (Weinberger letter to the President, October 18, 1982, reported in Military Manpower Task Force report, November 1982)

As reported by the Assistant Secretary of Defense, 1983 was even better than 1982. High quality accession levels were exceeded in every category as reported by the Assistant Secretary of Defense's series of monthly press releases. In his year-end report, the Assistant Secretary said, ". . . FY 1983 was the best year in the history of the all-volunteer force. . ."

The resources available in 1982 and 1983 were set using the 1979 and 1980 experiences, when recruiting indicators forecast problems ahead. As Secretary Weinberger stated, "In the late 1970s the recruiting and retention of qualified personnel for the Armed Forces had deteriorated to the point where many were questioning the effectiveness of the All-Volunteer Force." Actions were taken to counter the situation, and conditions changed. The Secretary continued, "We are pleased to report that there has been a dramatic improvement during the past two years. . . Three factors favorable to military manning were present . . . the more positive approach your (President Reagan's) Administration has taken toward national secruity and military service, the return of military compensation to competitive levels, and the scarcity of job opportunities in the civilian sector. As the economy recovers, military pay and benefits must be adjusted to sustain the attractiveness of military service relative to civilian life. If this is not done, we will find ourselves reliving the unfortunate experience of the late 1970s. . ." (Weinberger letter, Military Manpower Task Force Report)

The same very optimistic theme with a word of warning was carried in the June 12, 1984 OSD News Release (No. 326-84), "Assistant Secretary of Defense . . . Korb announced today that the active force strength as of March 31, 1984 was 2,138,500. This represents 100% of the March 1974 plan. . . All of the Military Services have met or exceeded their overall first half year (FY) 1984 recruiting objecives. . . 93 percent of all new recruits had a high school diploma . . .[and] 93 percent of the new recruits scored average or above on the enlistment test . . . For the Army, 89 percent of new recruits had high school diplomas, and 88 percent scored average or above on the enlistment test. If these trends continue, FY 1984 will be the best year in history in terms of the quality of new recruits for both the Department of Defense and the Army."

Although most of this report sounded very optimistic and not consistent with the Army's public statements, it did hint of recognition of the changing conditions. (As reported in previous volumes, a major change in recruiting conditions occurred between the March 31 effective date and the June 12 release date of the news release.) The release ended with the following warning, "While pointing out the first half success, Korb cautioned that recruiting in the current improved economic environment has become more difficult and that the Department of Defense will face an increased challenge in FY 1985 as the economy continues to improve. He stressed that continued Congressional and public support will be needed to ensure that the Department will be able to attract and retain the required number of quality personnel in the future."

The work of the OSD and Service staffs in developing the EEWS concept may account for inclusion of this warning, but it is important evidence that recognition of change had reached the senior OSD level. In spite of that recognition and the Army's publicly expressed concerns, the PPBS system has not made major resource and policy adjustments to meet the changing conditions as of July 1984. No systematic approach to adjust current year resources for changing conditions has occurred. OSD has exercised its limited authority to adjust resources and ceiling points within its Department-wide limits and reduced the effects of some probems -- a capability that did not exist in the 1970s, but notwithstanding those efforts, the evidence suggests the need for an ACPP to become part of the management system of the Department of Defense.

F. Conclusion.

It appears that interlevel communications, recognition lag, and resource reallocation responsiveness in 1984 are not substantially different from the way they were in 1977. This evidence suggests that the Department of Defense needs to make several systemic improvements. It needs better near-term accession forecasting techniques, improved interlevel communications, and more effective near-term procedures for adjusting recruiting resources to meet changing recruiting market conditions. The fact that the Department of Defense has commissioned this study and that all Military Services are cooperating in the study effort suggests that these needs are recognized.

The Enlistment Early Warning System discussed in previous volumes is aimed at improving the forecast techniques. The Accession Crisis Prevention Process (ACPP) discussed in the next chapter is aimed at enhancing DoD's near-term resource management capabilities. Both EEWS and ACPP working together should build on the current flexibility, improve interlevel communications, and help avoid accession crises by reducing both recognition lag and resource delays.

CHAPTER III
THE ACCESSION CRISIS PREVENTION PROCESS

A. Approach

The proposed Accession Crisis Prevention Process (ACPP) has five parts as discussed in Chapter I. They are:

1. Regular Manpower Secretarial Performance Reviews (SPRs);
2. Improvements in DoD's Planning, Programming, and Budgeting System and in the Congressional Authorization and Appropriation Processes (PPBSAA);
3. Improvements in Interlevel Communications;
4. A New Offline Adjustment Process (OAP); and
5. A New Immediate Crisis Avoidance Authority (ICAA).

The effects of the processes can be illustrated using the decision pyramid. In the previous chapter, the problems of interlevel communications recognition lag and resource delay were demonstrated by the decision pyramid. The first step in reducing these problems is to improve interlevel communications, itself one of the five parts of the ACPP. Improved int rlevel communications would steepen the slope of the left side of the decision pyramid as shown on Figure III-1 with a resulting reduction in the time required to recognize changes in recruiting conditions and in turn reduce the time required to change resources available in the field.

An offline budget adjustment process activated when EEWS warns that recruiting indicators have exceeded preagreed levels combined with regular SPRs would accelerate decision-making, help improve communications, reduce decision-

DECISION PYRAMID WITH IMPROVED COMMUNICATIONS

- IMPROVED COMMUNICATIONS
  - -- STEEPENS LEFT SIDE OF PYRAMID
  - -- ACCELERATES PROCESS

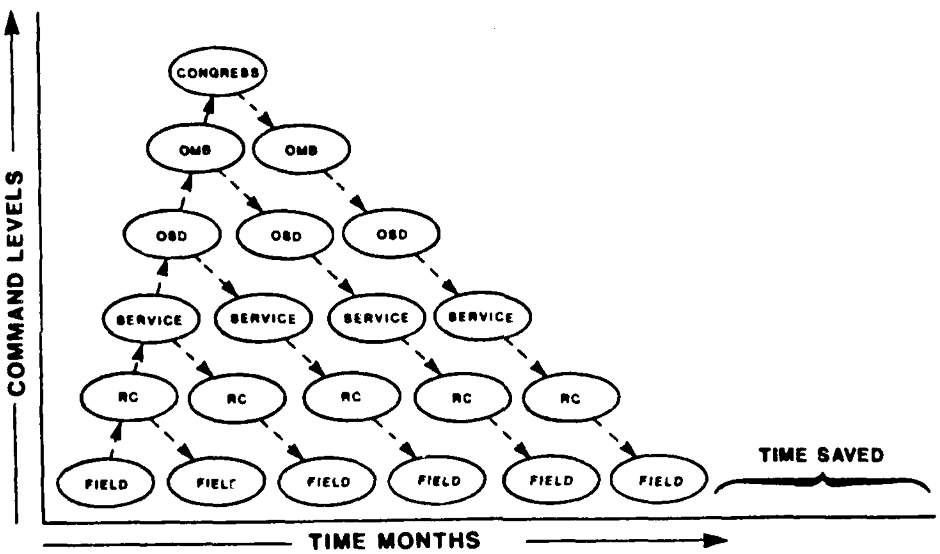

FIGURE III-1

making delays in the upper levels of the pyramid, and accelerate downward communications. These improvements would reduce resource delays, as shown on Figure III-2.

The ACPP would provide the Military Services additional authority to adjust resources and relax policies imposed from above when certain recruiting conditions exceeded preagreed limits. This additinal authority would occur automatically when recruiting conditions changed by an amount previously agreed upon during the Defense Planning, Programming, and Budgeting System (PPBS) and the Congressional authorization and appropriation processes.

Because this additional authority would push decisions down into the left-hand corner of the pyramid (Figure III-3) that now must be made high in the pyramid on an adhoc basis, it would further reduce recognition lags and resource delays.

Some adjustments in the current PPBS process and some modifications in the language Congress has imposed on recruiting authorizations and appropriations from time to time may be necessary to implement all of the proposed parts of the ACPP. More decision-making may be required during the PPBS, authorization and appropriation (PPBSAA) processes to establish the preagreed conditions that would trigger offline reviews of recruiting resources and provide additional authority to the Military Services.

The ACPP would build on the current organizational structures both for making current year recruiting resource reallocation decisions and for making PPBSAA decisions. This concept does not envision radical organizational changes such as a joint recruiting command, nor does it diminish the

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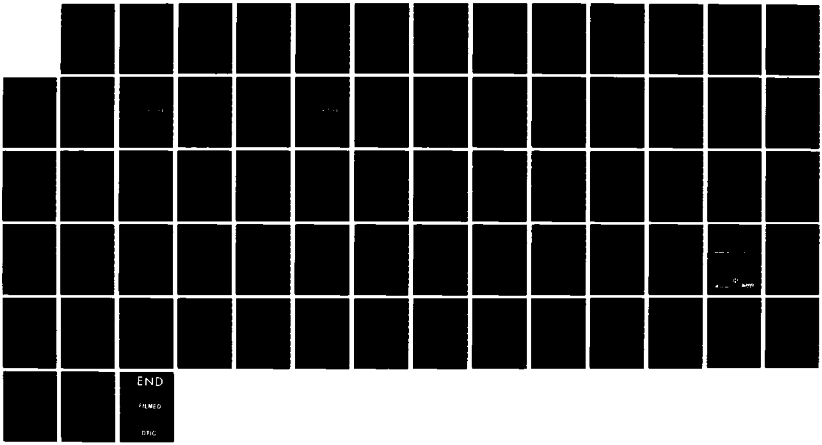
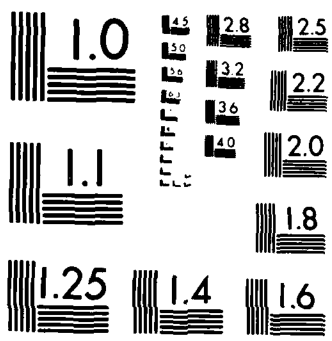




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

DECISION PYRAMID WITH OFFLINE BUDGET ADJUSTMENT PROCESS

- IMPROVED COMMUNICATIONS
  - -- STEEPENS LEFT SIDE OF PYRAMID
  - -- ACCELERATES PROCESS
- OFF-LINE ADJUSTMENTS
  - -- REDUCE TIME IN UPPER-LEVEL REVIEW
  - -- ACCELERATE PROCESS

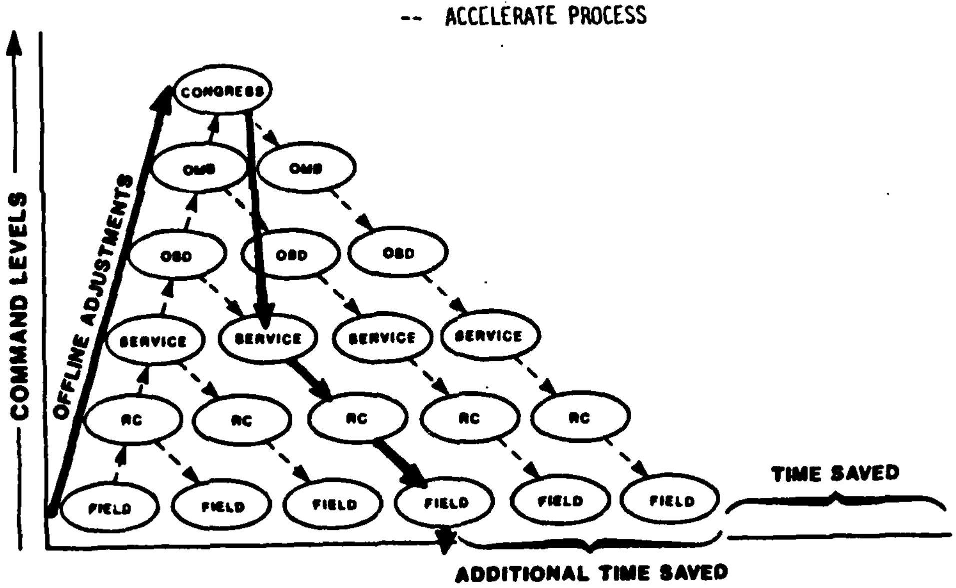


FIGURE III-2

DECISION PYRAMID WITH IMMEDIATE CRISIS AVOIDANCE AUTHORITY

- IMPROVED COMMUNICATIONS
  - -- STEEPENS LEFT SIDE OF PYRAMID
  - -- ACCELERATES PROCESS
- OFF-LINE ADJUSTMENTS
  - -- REDUCE TIME IN UPPER-LEVEL REVIEW
  - -- ACCELERATE PROCESS
- IMMEDIATE CRISIS AVOIDANCE AUTHORITY
  - -- AUTHORIZED WHEN PREAGREED CONDITIONS OCCUR
  - -- LIMITED TO BLUE TRIANGLE
  - -- ACCELERATES SHORT-TERM CORRECTIVE ACTION

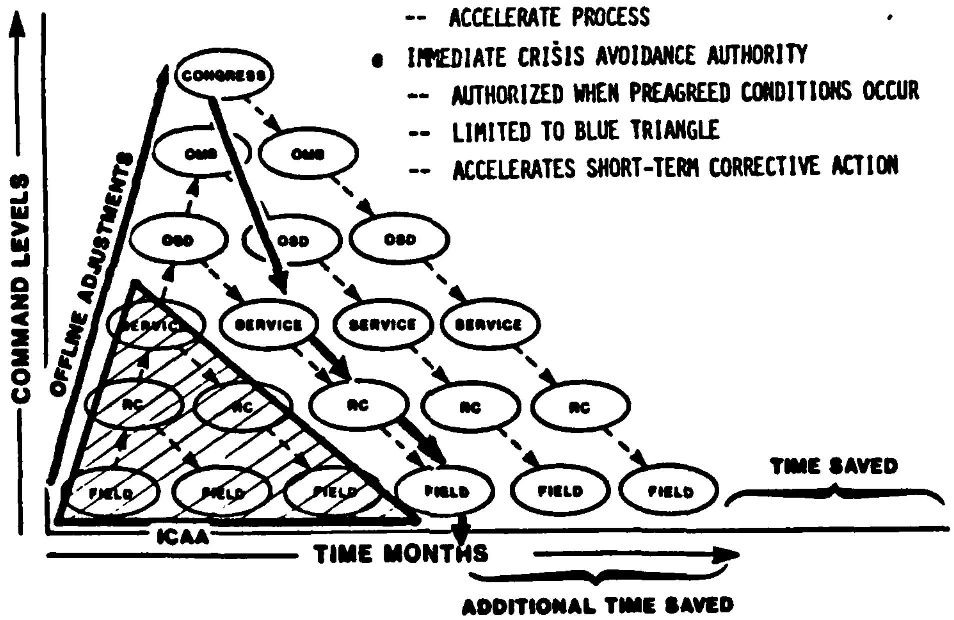


FIGURE III-3

authority or roles of Congress, the Office of Management and Budget, the Office of the Secretary of Defense, or the Military Services. To the contrary, it would enhance information flow and enlighten management at all levels. It would provide the Services with more management flexibility than they now have, would take advantage of the warnings of potential accession problems now available, and would ensure effective use of the improvements in early warning discussed in the previous volumes of this report.

A simple analogy to fire prevention and fire fighting may be useful to bring the five elements of the ACPP into focus. The PPBSAA process may be parallel to the fire emergency and fire prevention plan. If it works correctly, there may be no need for the other factors. It prescribes what to do if a fire warning is sounded. When the recruiting resource levels set by the PPBSAA processes for the budget year are appropriate for the conditions that actually occur, none of the other parts of the ACPP would be activated. When recruiting conditions deviate beyond the limits established in the PPBSAA processes, alarms would be sounded.

Just as a good fire emergency plan provides for appropriate actions when there is evidence of a fire, the PPBSAA processes should provide for resource reconsiderations when its resource allocation assumptions are no longer applicable.

Improved communications may be considered parallel to a good smoke-heat alarm system. Through the EEWS, a warning would be sounded that would notify everyone that changes in recruiting conditions have exceeded preagreed limits.

Activating the offline adjustment may be considered parallel to calling the fire department. Just as the fire emergency plan calls for the fire department to come to the fire, to evaluate the situation, and to take appropriate action based on human jusgement, the EEWS and ACPP provide for human assessment to determine that the change in recruiting conditions is valid and to take the appropriate corrective actions.

The additional authority provided by the Immediate Crisis Avoidance Authority (ICAA) process may be considered parallel to activating an automatic sprinkler system when the alarm sounds. Occasionally the automatic system may be activated when it is not needed and cause some inconvenience; but, if there is a fire, the system contains the damage until the fire department arrives.

Just as a good fire prevention program provides for regular inspection and review to be sure it will work when necessary, the regular reports of the EEWS and monthly review at the working level and semiannual Secretarial review provide appropriate continuity and oversight.

This analogy to a fire prevention system may be useful to keep in mind while studying the five parts of the Accession Crisis Prevention Process discussed in detail in the remaining sections of this chapter. The remainder of the chapter is organized as follows:

- Secretarial Performance Reviews (SPRs) for Manpower,
- PPBS-Authorization-Appropriation (PPBSAA) Cycle,
- Improved Interlevel Communications,
- Offline Adjustment Process (OAP), and
- Immediate Crisis Avoidance Authority (ICAA).

B. Secretarial Performance Reviews (SPRs) for Manpower

Secretarial Performance Reviews (SPRs) now are a regular part of the Defense Management Processes. Key weapons systems and large procurements are reviewed periodically by the Secretary of Defense, the Secretaries of the Military Departments, and their key military and civilian assistants. The Director of Program Analysis and Evaluation in meetings with the study team indicated that this process has been very effective and could be used for broader managerial purposes, such as those contemplated in the ACPP concept. Relevant topics could include: military pay levels, incentives, recruiting, and other manpower and personnel issues of Departmental significance.

The concept as it is now included in the ACPP envisions regular Secretarial Performance Reviews (SPRs) that would bring together the top management of the Defense Department to consider manpower issues, just as they consider weapons systems procurement issues. At least as considered in this strawman, these reviews would be held semiannually -- in the late Spring and the early Fall. As one of its regular agenda items, the Spring SPRs could consider the recruiting situation as the Department moves into the prime recruiting period. The top leadership could be made aware of recruiting conditions, near-term forecasts, and any offline adjustments that may be pending.

Although SPRs are not usually used for resource allocation purposes now and would not be intended as decision forums under the concept proposed here, they now provide the top leadership with a common base upon which to make decisions and provide a forum for discussing important procurement topics of continuing interest. Similarly, Spring

Manpower SPRs could be used to keep top leadership aware of recruiting conditions and any potential increases, decreases, or redistributions of resources being taken to meet changing recruiting conditions.

The Fall SPRs probably would focus on the annual pay raise issue and help establish a Department of Defense position on the most important incentives early in the budget development cycle. Such a review would help link pay decisions to recruiting and retention conditions.

In any case, these SPRs should be initiated by the Assistant Secretary of Defense for Manpower, Installations, and Logistics as he deems appropriate. They would provide a forum for highest level consideration of the more important manpower issues facing the Department during the key recruiting and resource allocation periods each year.

C. PPBS-Authorization-Appropriation (PPBSAA) Cycle

The formal PPBSAA resource allocation and budget control system is very important to the effective implementation of the Accession Crisis Prevention Process (ACPP). Development of the Five Year Defense Plan (FYDP) would continue to be the central planning process. The Service Program Objective Memoranda (POMs) would continue to be the primary accession resource programming vehicle. The President's annual budget would contain the formal request for resources, and the congressional authorization and appropriation processes still would constitute the ultimate resource control. The important institutional roles of Program Analysis and Evaluation (PA&E) and the Comptroller in the Department of Defense, as well as those of OMB and the Congressional Committees, would be enhanced by the ACPP, not circumvented by it.

Defense guidance in POM preparation would provide guidelines for the accession program development just as it has in the past. The military Services would use that guidance together with their own forecasts of recruiting indicators and their manpower requirements for new personnel to develop the recruiting resource sections of their POMs. Very little additional information would be required of the Services.

Currently, to develop their programs the Services must gather the information and make most of the decisions discussed in the ACPP. What will be new is the linking of assumptions to resource requests through the budget development, resource approval, and spending processes. As the system now works, those assumptions often are lost along the way. High level decision-makers and recruiting managers often are unaware of the assumptions that were used 2 or 3 years ago to justify the current levels of recruiting resources. If recruiting conditions today are not fairly close to what was assumed at budget development time, then the current resource levels may be inappropriate for current needs. Excess resources may be underutilized, or recruiting goals may be unachievable. The recruiting resources should be reviewed whenever reality varies significantly from the assumed recruiting conditions. The ACPP would accomplish this function by establishing validity limits on the resource allocation assumptions. If the EEWS shows that these limits have been exceeded, the OAP and ICAA processes would be activated.

The ACPP would link assumed recruiting conditions not only to the POM requests as is done now, but would carry them through budget development, Congressional authorization and

appropriation, reapportionment, Service spending plans, and the Service Recruiting Command's operational cycle. The Services would submit the range in conditions in which they would consider their recruiting resource programs to be valid. They would propose upper and lower limits for the indicators of recruiting conditions beyond which they would expect offline adjustment reviews to be initiated. They also would propose floors on recruiting indictors below which they would need additional authority and resources (called in this report Individual Crisis Avoidance Authority or simply ICAA) to permit them to shore up recruiting while the OAP was being completed.

The OSD staff would review these proposals and raise issues as may seem appropriate; and the Secretary of Defense would adjudicate differences and approve OAP and ICAA levels, just as he now approves the recruiting resource levels. The ACPP assumptions and trigger points would become a part of the Defense budget proposal and be reviewed by OMB and approved by the President. They would be included in the President's annual budget and be part of the Congressional authorization and appropriation considerations. They would help shape the appropriation's language that controls spending of recruiting resources. The reapportionment decisions and resulting Service spending plans would carry along the conditions under which the recruiting resources would be considered valid and the points at which offline adjustment review would be considered necessary and ICAA would be activated.

During the recruiting year, the OSD staff and the Services would closely monitor recruiting conditions with the Enlistment Early Warning System (EEWS) to ensure that the

current conditions and near-term forecasts are within the limits established for the current recruiting resource levels. If the EEWS sounds an alert, the Human Assessment Group would evaluate the situation. If it issued a warning, and OAP review would be initiated. Under the appropriate preagreed conditions, the ICAA would be activated.

The PPBSAA controls the ACPP. It provides legitimacy to the resource decision processes. Without approval of this system, the ACPP would simply be another ad hoc process and would suffer from the same problems as the current system. Incorporating the ACPP into the PPBSAA system provides systematized review and approval of the preagreed conditions associated with changing recruiting resources to respond to changes in recruiting conditions and recruiting indicators. It integrates the other ACPP improvements into the regular management system of the Military Departments, the Department of Defense, the Executive Office of the President, and the Congress.

D. <u>Improved Interlevel Communications</u>

The Enlistment Early Warning System (EEWS) would improve interlevel communications significantly. Each month all levels would receive a comprehensive report on the recruiting status and near-term projections of recruiting conditions (see Volume V). The Offline Adjustment Process also would help institutionalize improved commuications by requiring prompt multilevel consideration of warnings.

It is inappropriate for higher levels in the pyramid to share all of the data that exists at the operating level. That would inundate the system and create more management problems than it would solve. What is needed is a

communications systems that compiles relevant valid information and conveys it rapidly to the appropriate managers. All of the levels need to know when the EEWS shows significant changes in recruiting conditions. Recognition delays, especially at the higher levels in the pyramid, must be reduced if accession crises are to be avoided in the future.

Experience indicates that lower levels in the pyramid do not report consistently; sometimes they strive to meet their assigned goals and objectives, often masking changes in conditions by extra effort until most of the elasticity in the system is expanded. At other times they cry wolf without justifiable cause. These phenomena use up the elasticity that normally would provide time for higher level decision-makers to consider the facts, reach consensus, and direct timely corrective action. These masking phenomena contribute to the recognition lag discussed above.

Improved communications would help reduce this masking problem. It would be most helpful during transition periods, when recruiting reports indicate accession objectives are being met but the EEWS signals deteriorating conditions that portend near-term recruiting problems. In these circumstances, EEWS would sound an alert that would require multilevel review. Higher level managers would begin asking the Services what is happening and what corrective action is needed. The system would call for action. Instead of the Services trying to persuade reluctant and doubting higher level managers to focus on an, as yet, unidentified problem, the new system would be raising consciousness at all levels before a serious problem developed. Recruiting resource management could become a proactive, crisis avoidance, management system, instead of a catch-up, reactive, feast-or-famine system.

As a result of better communications, Service policy and resource requests would have more credibility at higher levels. When common data bases support Service requests and independent analyses confirm Service observations, recognition lag is reduced and prompt approval of the needed resources is more likely.

Improved interlevel communications would enhance reprogramming actions and supplemental appropriations should they be needed. Even more important, they facilitate corrective actions before conditions deteriorate to a situation where a crisis is imminent and emergency actions are required. Improved communications contribute to crisis avoidance. Improved regular interlevel communications are essential for the ACPP to work.

E. Offline Adjustment Process (OAP)

The first of two functional improvements to adjust resources to meet changing recruiting conditions is the Offline Adjustment Process. The improvements in the PPBSAA system and improved interlevel communications are essential for this process to work effectively. It is not a magic solution to all recruiting problems. It only brings the regularly responsible actors together and focuses them on changing recruiting conditions more promptly and in an organized and disciplined manner. It is designed to respond to changing conditions and not waste management time in unproductive meetings when conditions are normal.

Three action levels are contemplated in this process:

1. Secretarial Performance Reviews (SPRs)

As discussed in section B above, recruiting would be one of the important personnel issues considered by the semiannual Manpower SPRs. SPRs would provide high level awareness of recruiting conditions and Secretarial guidance to the Offline Adjustment Process.

2. Senior Level Coordinating Committee

The primary management level in the process is the Senior Level Coordinating Committee. This Committee would be chaired by the Assistant Secretary of Defense for Manpower, Installations, and Logistics and be composed of the Assistant Secretaries of the Military Departments and Deputy Chiefs of Staff for Manpower. The Defense Comptroller, the Director of Program Analysis and Evaluation, and the Associate Director of the Office of Management and Budget (OMB) would complete committee membership.

These are the people responsible for program and budget decisions affecting the recruiting efforts. They are the ones who must reach consensus on most crucial issues to effect substantial changes in midyear resource levels. Experience both past and recent indicates that it is very difficult on an ad hoc basis to bring these important managers together to consider changing recruiting conditions before the actual accession shortfalls occur. To institutionalize the concept that they ought to consider warnings issued by their working levels and promptly initiate and approve resource changes when recruiting conditions change is a central feature of the ACPP concept.

CHAPTER IV
FEASIBILITY ANALYSIS

A. Approach

Proving that a new idea is feasible without actually doing it is very difficult, if not impossible. The best one can do is to explore the potential alternatives and draw inferences from the information that is available.

Three approaches can be used. The first approach seeks consensus from those knowledgeable in the field. The second approach uses models to simulate actual operations. The third approach uses pilot programs to give insights into larger scale operations. All three approaches lead to incremental development and testing of a concept until it finally reaches an operational level. In all of these approaches, one should look for potential problems that would render the idea infeasible or at least raise questions about its desirability. Many potential problems can be solved or accommodated during the evaluation processes. If as a result of one or a combination of these approaches, one fails to find a reason to preclude the new idea, one may draw the inference that the concept is feasible.

The final steps in the decision process are to decide if the proposal as it finally emerges is better than the current process and if it, therefore, should be implemented.

The first approach has been used to test the feasibility of the Accession Crisis Prevention Process (ACPP) during this first phase of the study. The second and third approaches are proposed for phases II and III of the study. The final

conclusion perhaps understates the case. With the ACPP resource timing would be more appropriate, the required flow of high quality accessions would be more steady and accession crises would be less likely to occur than is now the case.

The ACPP is not a panacea and would not end recruiting problems, but it would help the managers cope with the inevitable uncertainty of long-range budgeting in a volatile labor market and would facilitate making adjustments when recruiting conditions change rapidly. An effective ACPP would reduce wasted resources when recruiting conditions turn out better than expected by permitting banking of resources for when they are needed. Whe conditions rapidly deteriorate, the ACPP provides a plan of action and resources to meet the change in an orderly and efficient manner. As now conceived, the ACPP would avoid accession crises and conserve recruiting resources.

ACPP ADJUSTS RESOURCE SPENDING TO MAINTAIN ACCESSIONS

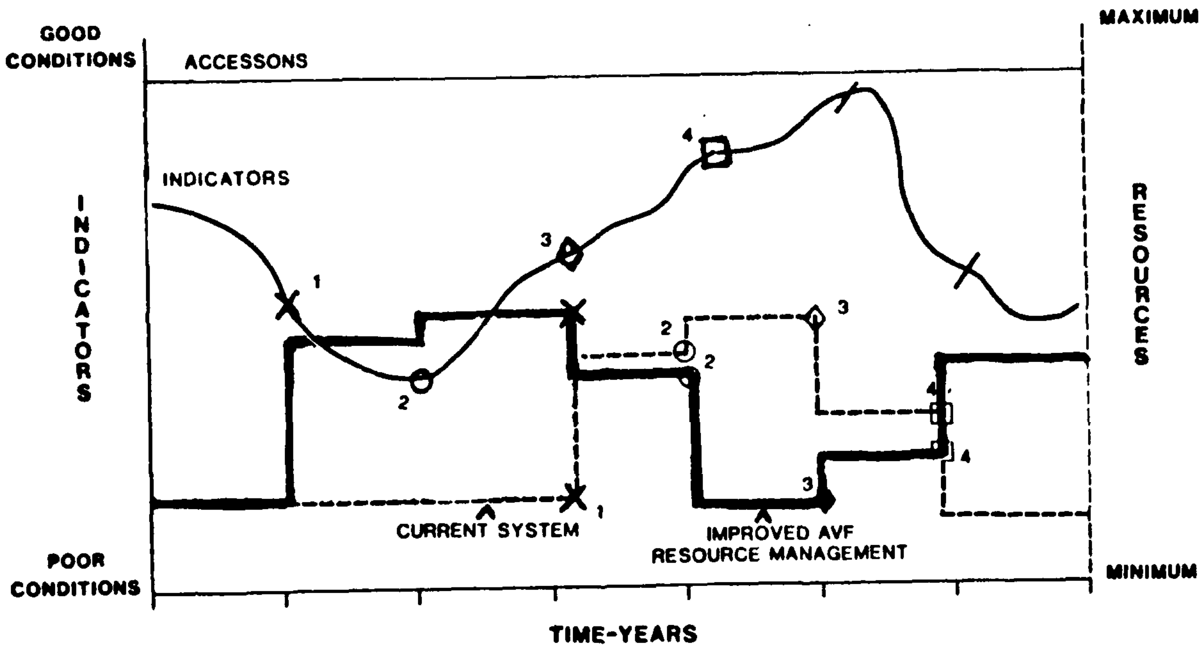
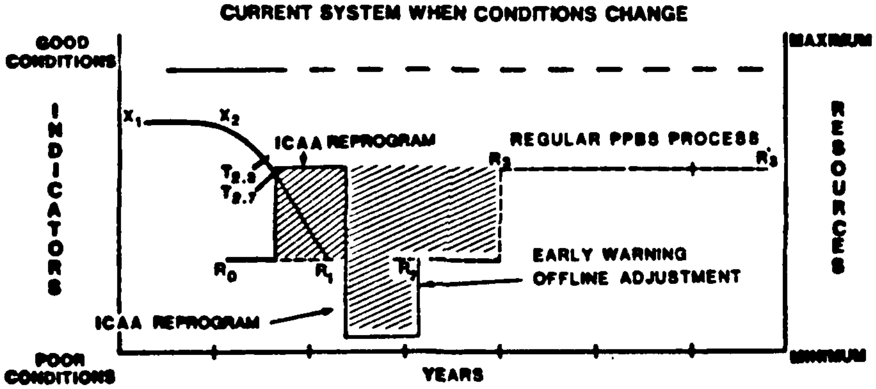


FIGURE III-8

HOW ACPP WORKS

WITH EARLY WARNING OFFLINE ADJUSTMENT

HOW THE PROPOSED SYSTEM AVOIDS PROBLEMS OF CURRENT SYSTEM WHEN CONDITIONS CHANGE



AT $T_{2.7}$, THE RECRUITING COMMAND EXERCISES ICAA, AS AGREED UPON IN THE PPBS PROCESS FOR SETTING RESOURCES. ICAA WOULD REPROGRAM RESOURCES FROM LATE IN R_1R_2 TO USE IN R_0R_1 AND EARLY R_1R_2. THE OFF LINE RECONSIDERATION TRIGGERED BY $T_{2.3}$ AND $T_{2.7}$ WOULD FILL IN THE SHORTFALL.

FIGURE III - 7

HOW ACPP WORKS

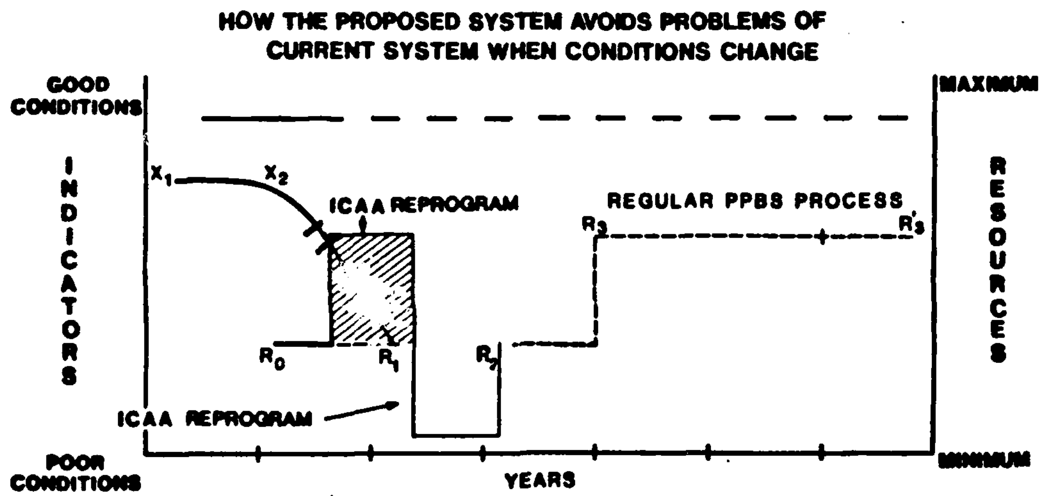


FIGURE III-6

levels at the other points in the system. When conditions were no longer valid, all of the levels would be expected to review existing resoure levels and make appropriate adjustments.

Improved communications would ensure that all levels have access to the same information and would focus debates on the serious problems and the appropriate corrective actions instead of on whether or not there is a change taking place in the labor market. Improved communications is central to the other parts of the system. Because the PPBSAA would set preagreed conditions for the activation of the Offline Adjustment Process and the initiation of ICAA, action would be expected when conditions exceed the preagreed limits. This acceleration in recognition and response rates would reduce the lags that have permitted serious accession shortfalls to occur in the past.

As shown on Figure III-6, when a decline in recruiting triggered the ICAA, the Services could reprogram resources to contain the problem. During the same time period, the Offline Adjustment Process would review near-term resources and make appropriate adjustments, as shown on Figure III-7. The longer-term POM and budget development processes would adjust outyear resource levels as they do now.

The indicators line and the dashed current system resource line on Figure III-8 are the same as those on Figure II-2. The heavy black line shows the hypothetical spending line with ACPP in operation. With a properly functioning ACPP resources would be increased when needed and conserved when conditions improve. Over the years about the same total amount of resources would be spent under both systems, but with ACPP they would be spent more efficiently. This

Not only is the authority provided, but because it is part of the plan, action will be expected. This ICAA feature of the ACPP concept anticipates that Service managers will adjust their resources to meet changing conditions, notify appropriate authority through the offline process, and help the Congress, OMB, and OSD meet both their oversight and crisis avoidance responsibilities.

The ICAA is a near-term, emergency procedure to avoid accession crises, while the offline adjustment process is assessing midterm corrections and the POM process is developing long-range solutions. The details that would activate the process are established annually as part of the PPBSAA. Unlike the Offline Adjustment Process, the ICAA is an <u>add only</u> process that would be triggered automatically when preagreed conditions exist. Although it would be triggered automatically and immediately give the Services additional near-term authority, it would not automatically adjust any resources or programs. All changes would be made by Service managers who may find the new authority and the new expectation for action a refreshing change from the frustrating restrictions of most other management processes.

G. How ACPP Works

The five parts of the ACPP are expected to work together to improve the Department of Defense's response to changing labor market conditions. Better documentation in the PPBSAA processes would link resource levels to recruiting conditions all the way through the process. This would not greatly increase the level of work in the Services where those links must be made now to develop recruiting resource requests, but it would focus attention on conditions as well as budget

F. Immediate Crisis Avoidance Authority (ICAA)

The second major functional improvement to adjust resources to meet changing accession conditions is the Immediate Crisis Avoidance Authority (ICAA) concept. ICAA is perhaps the most important single feature of the ACPP. In our analogy, it was the sprinkler system that contained the fire while waiting for the fire department to arrive and be sure the fire is under control.

It is this damage limiting feature of the ICAA that gives vitality to the ACPP and is particularly attractive to the Army staff.

On our management pyramid (discussed in the previous chapter) this authority operates in the lower left-hand corner of the pyramid, reducing both recognition and response lags. In many program areas, the Services already have authority to make adjustments, but recruiting is a "high interest" item in the Congress and often is more closely managed than most other programs of similar cost. Recognition of this special interest and the need to accommodate strict oversight and still provide the necessary management flexibility underlies the ACPP approach.

As long as the conditions associated with the recruiting resource levels persist, all of the oversight restrictions apply. But under the proposed concept part of those restrictions will be a preagreed set of conditions that will require offline reconsiderations and another set of preagreed conditions that will automatically grant the Services additional authority to take actions necessary to avoid immediate accession crises.

INTERFACE BETWEEN EEWS AND ACPP

INCLUDING LINKAGE BACK TO SERVICES

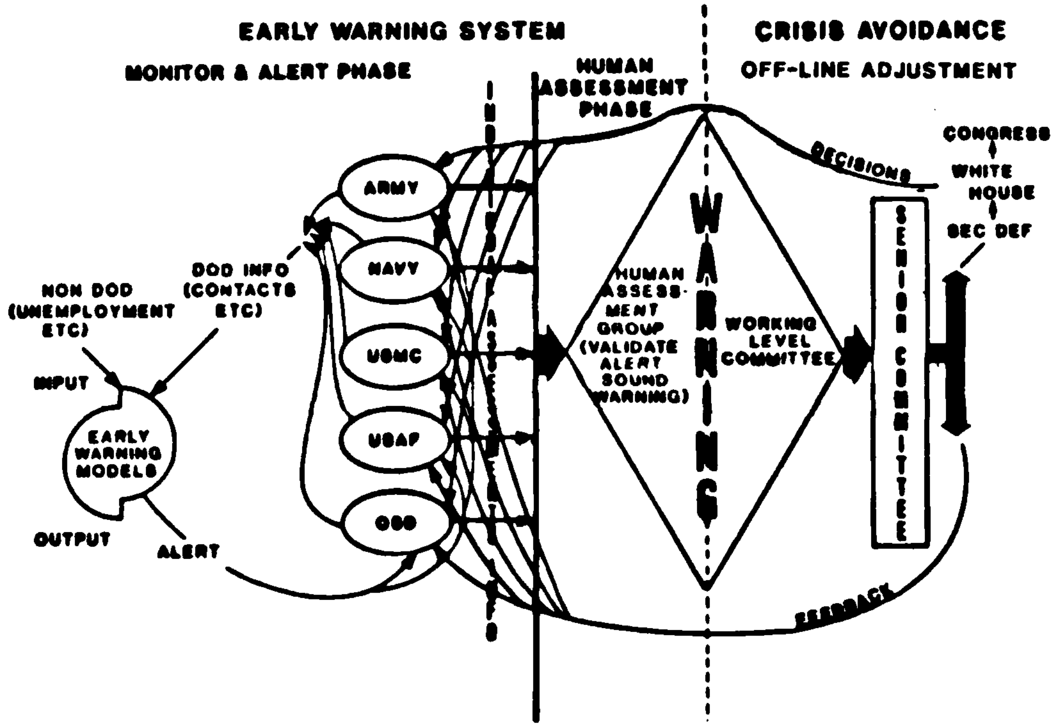


FIGURE III-5

One of the primary functions of the Offline Adjustment Process would be to facilitate resource adjustment when the EEWS indicates that recruiting conditions are changing. Currently, resource adjustments made in response to such changes are incorporated in the POMs being developed by the Services for future years. Often the POM and budget lead times are such that they cannot meet the need for near-term adjustments as recruiting conditions change. The change in conditions often call for recruiting resource adjustments in the current or the budget years, as well as in the POM years. The existing PPBS process permits some interdepartmental readjustments under stable conditions, but does not facilitate adjustments when everyone is experiencing problems. Such adjustments are now made ad hoc, if at all. It is this offline nature of the process that leads to its name, but that should not convey the idea that it is not to be part of the PPBSAA system.

To the contrary, as discussed above, one of the important considerations to be added to the PPBSAA is direct linkage between approved resource levels and the recruiting assumptions linked to those levels. The PPBSAA would establish consensus about what conditions would require the Offline Adjustment Committees to meet. Of course, the system also would respond to the request of any member for meetings to consider changes in recruiting conditions even if the EEWS did not sound a warning. Figure III-5 shows the complete interface between the Offline Adjustment Process and the Early Warning System, including the linkages back to the Services.

Assessment Group, the same people who composed that Group become the ACPP Working Level Committee to develop and recommend actions to be taken to solve the problem. Having made the assessment, they would be the people with the best knowledge of the problem and what could be done to solve it. They would have a timely awareness of changing recruiting conditions, the EEWS forecasts, and existing conditions in their respective Services or organizations. They could provide forward planning for preventive actions and could accelerate implementation of needed resource and policy adjustments.

Obviously, a group of relatively junior officers would not function in isolation of their respective Service staffs. This process would not preclude Service action and indeed is intended to facilitate such action. Command and management levels in the Service and OSD staffs would continue to exercise their authority and provide guidance and control to Working Committee members. The important difference is that, under the new system, the working level members would meet together often, would understand the process and the data, and would avoid long delays that now occur between the time that changes in data occur and action on those changes begin.

The output of the Working Level Committee would go to the Senior Level Committee where broad program perspective could be added to the action officer depth of knowledge. The results of senior level actions would be fed back to the Services for implementation or to the Secretary of Defense for decisions that require higher level consideration, perhaps including the SPR.

INTERFACE BETWEEN EEWS AND ACPP

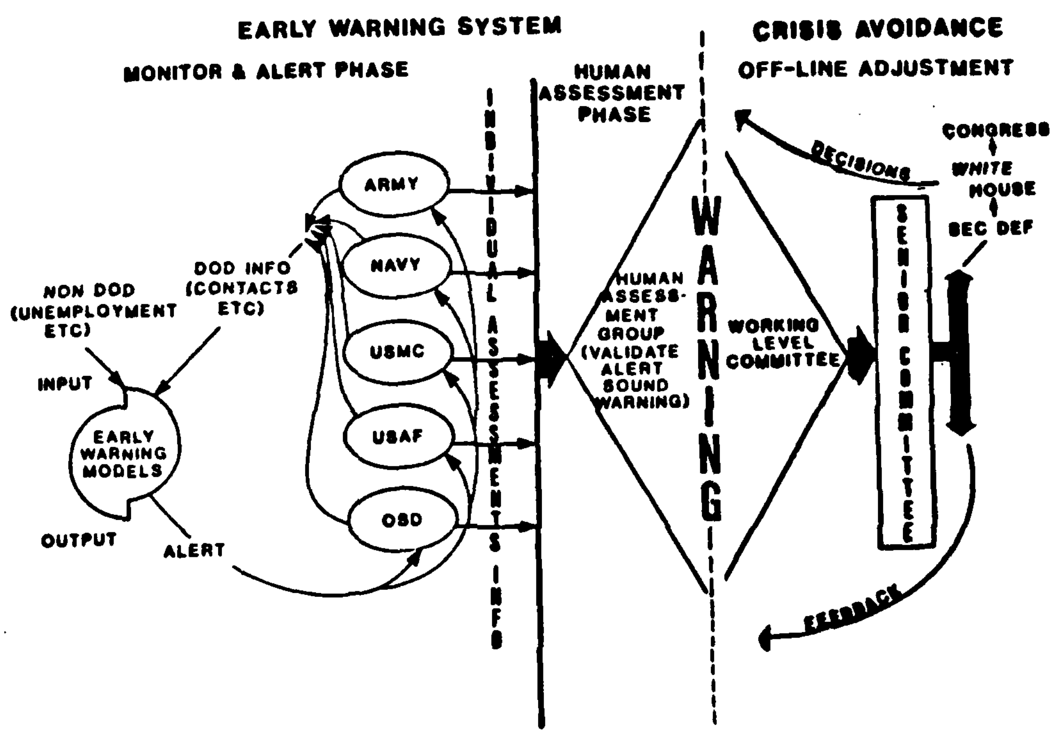


FIGURE III-4

The Working Level Committee would be chaired by a member of the Accession Policy Staff in the Office of the Secretary of Defense. Membership would include representatives of the four Services and staff from the OSD Comptroller, OSD PA&E, and OMB. The purpose of this committee is to bring together working level personnel with indepth knowledge of both the current EEWS forecasts and the Service's recruiting system (including recruiting policies, procedures, and resources) to develop and recommend actions when an accession warning is issued. As shown on Figure III-3, the ACPP Working Level Committee is essentially the same people who formed the EEWS Human Assessment group and who issued the warning. Having determined that a potential problem exists, they are the best people to begin to structure solutions to that problem.

The Study Team recognizes that there are important management levels between the working level and the senior level. These levels would be important to the process, would provide direction to the working level and recommendations to the senior level, and may meet on their own to resolve certain problems or coordinate recommendations. The ACPP does not mean to reduce their role in the process, but the three levels discussed seem sufficient to provide a framework for coordination. Clearly, other levels may meet and function within this framework, but ought not to be required to do so for the system to function. Figure III-4 shows the relationships of the various levels within the Offline Adjustment Process and their relationship with the Military Services and the Enlistment Early Warning System.

Figure III-4 builds on the illustration of the Early Warning System shown on Figure I-2. It illustrates the monitor and alert and the human assessment phases of the EEWS. When an accession warning is issued by the EEWS Human

When recruiting conditions were (to use the Secretary's words) "the best ever," the Senior Level Coordinating Comittee may not have met at all or would have met to discuss ways to bank excesses in recruiting resources in anticipation of changing conditions. If in the midst of that "best ever" period recruiting conditions began to deteriorate, the EEWS would sound an alert and, if appropriate after human assessment, issue a warning. When the EEWS issues an accession warning or a Service raised concern about changing conditions, the Committee would meet promptly to consider the evidence and act on the recommendations of the Working Level Committee.

This committee would not take away Service prerogatives. The Services would still manage their recruiting programs and would need no more approval than the current system expects. The ACPP, however, would coordinate Service efforts into a Defense plan of action. Rather than individual Services sounding alarms and arguing with each other publicly about the seriousness of changing conditions, with this process the responsible managers would meet together and develop a Department-wide strategy to respond to changing conditions.

3. Working Level Committee

At the action level, the ACPP needs a Working Level Committee to interface with the EEWS and initiate action to correct recruiting resource imbalances when a warning is issued. The Working Level Committee would be composed of middle managers responsible for accession programs appointed by the respective members of the Senior Level Committee. They would be similar to the Study Advisory Group that has participated in this study effort. They also would be the people who participated as the Human Assessment Group in the EEWS Phase.

determinations to implement some or all of the concepts should be made after completion of all of the study and testing phases.

In this first phase, the concepts have been developed through a series of interactions with crucial participants in the accession management system. These participants include the Office of the Secretary of Defense, the Military Services, and the Office of Management and Budget.

The contract is sponsored by the Office of Accession Policy in the Office of the Secretary of Defense. The contractors have worked closely with that office throughout the project.

Early in the research effort, a Study Advisory Group (SAG) was formed with representation from all four Military Services (both from their headquarters manpower organizations and their recruiting commands). The concepts were hammered out in a two-day workshop (March 22 and 23, 1984) that provided in-depth one-on-one interchanges of ideas and then were refined in a series of briefings to various levels in the Services, OSD, and OMB.

The Deputy Chiefs of Staff for Manpower from the four Military Services were involved in discussions of the concepts with the Deputy Assistant Secretary early in the process. Detailed presentations were made and discussions held within the OSB staff, with the Service staffs, and with staff officers at the Office of Management and Budget.

Although none of these discussions were intended to solicit formal approval of any of the organizations involved, they were analytical in nature and generated ideas that have

been incorporated in the concept. All participants agreed that the problem was relevant and that the approach was original and innovative. Some questioned if the problem calls for a systemic change of this magnitude. Perhaps only parts of the solution should be implemented and others deferred to see if they are really needed.

No one objected to the concept itself, but many questions were raised about details. The ideas of preagreements, banking resources, and offline adjustments were of particular concern. Some wondered if the Congress would permit implementation of these ideas short of crisis conditions. Some points were raised about how the ACPP would change programming and budgeting.

For example, there was a concern that a result of the ACPP would be budgets that always understate resources to permit funding of weapons systems and other favorite programs, because accessions ultimately would be funded at the required level. Further discussions resulted in a consensus that such an outcome might not be all bad. It might avoid some waste in the accession program while assuring that required resources would be available when needed.

The possibility of banking resources in rich times (if that idea became part of the process) would permit reprogramming extra resources for later use when they can be spent more productively.

B. Feasibility of the Parts

In this section, the feasibility of each of the five major parts of the ACPP are discussed.

1. Secretarial Performance Review

This concept was added at the suggestion of the OSD Director of Program Analysis and Evaluation. There appear to be no objections to the concept. It is a regular part of the DoD management system. Obviously, the Secretary of Defense and the Assistant Secretary of Manpower, Installations and Logistics would have to support the concept for it to be viable. The following pros and cons should be considered.

Pros:

a. SPR is part of the current management system;
b. SPR focuses top management on key issues; and
c. This concept treats manpower like systems.

Cons:

a. The SPR may raise issues too high, too fast;
b. There may not always be issues important enough for an SPR; and
c. This application would broaden the concept of SPRs.

The concept of holding regular manpower SPRs is feasible.

2. PPBS-Authorization-Appropriations (PPBSAA)

The PPBSAA preserves the roles of the Services, OSD, OMB, and the Congress in the resource allocation process, but provides new flexibility within the PPBS and Congressional processes to meet near-term requirements when recruiting conditions change. Documentation of the assumptions underlying the recruiting resources will be carried with those resources throughout the process. The PPBSAA provides management control of the Offline Adjustment Process and the Immediate Crisis Prevention Authority and is essential to implementation of either of those processes.

The Services now generate most of the information needed for the PPBSAA. Including additional information in the POMs does not seem to be a serious burden to them, or at least is a burden they would accept to have the additional flexibility the ACPP offers. OSD PA&E and Comptroller have major roles to play in the PPBSAA and must be strong supporters for it to work.

Pros:

a. PPBSAA would help improve interlevel communications;
b. PPBSAA would work within the current system;
c. The concept is strongly supported by OSD PA&E;
d. There is general support from OSD Comptroller and OMB staffs; and
e. It is essential for other parts of system to work.

Cons:

a. Comptroller reluctant to support preagreement;
b. Congress may become more involved in detailed micro-management;
c. There is a potential for gaming; and
d. No one knows exactly how it will work.

On whole, the PPBSAA process probably is feasible. The POM concepts certainly are feasible. The preagreed triggers and conditional funding are less certain. Prototypes of the PPBSAA should be developed and evaluated in phase II, and the feasibility and desirability should be reconsidered.

3. Improved Interlevel Communications.

Improving communications is a "motherhood" concept that receives near universal endorsement, at least until specifics are considered. If one point has been clearly made during the research on this study, it is the need for improved and institutionalized communications concerning recruitment conditions. Recognition lag is greatly amplified by slow, hit or miss communications.

The study team believes establishment of EEWS and ACPP in itself will improve the accuracy, extent, and timeliness of interlevel communications. The SPRs will result in an update of the senior members of the OSD and Service staffs every six months. The Human Assessment Group and Working Level Committee will maintain a

continuous working relationship among the Services, OSD and OMB action officers. The recruiting commanders already meet regularly, but the EEWS and ACPP will provide a common data base for their discussions of near-term issues. A formal mechanism will be in place to bring the Assistant Secretaries and the three star level together in a timely manner to respond to specific situations and will provide a common data base for their deliberations.

There is every reason to believe that this system can be built and operated at a minimum cost and probably at an overall savings of resources. It does require the sharing of some information that sometimes has been held closely by various participants, but improving communications inherently requires increased sharing of information.

Pros:

a. Everyone subscribes to improved interlevel communications;
b. Improvement is seriously needed; and
c. Improved communications will result from implementing EEWS and ACPP.

Cons:

a. Improved communications may increase micro-management;
b. The information may be misused to hurt recruiting; and
c. It is two-edged; resources can be cut as well as added.

Improved interlevel communication is feasible. Implementing the EEWS and ACPP in itself will improve communications. Increased trust at all levels will be required as a predecessor to improved communications. Distrust, suspicion, misuse of information provided, and selective withholding of information tend to inhibit communications.

4. Offline Adjustment Process (OAP)

The OAP has been discussed in considerable detail previously. It is at the heart of the ACPP and was compared to the fire department in the analogy. It represents a substantial innovative change in DoD resource management.

A formal method is needed to adjust near-term resources to meet recruiting needs as conditions change. The OAP is designed to meet that need. It is the part of the system that takes best advantage of the EEWS forecasts.

The OAP concept is centered around committees, but these committees would not be extra levels imposed on the system. These committees would be composed of those who must respond to the changing conditions and control the resources that must be adjusted. These committees would bring together those people who must work together if near-term resource problems are to be solved.

Ultimate responsibility rests with the Services to make adjustments, but coordination and approval often must be received from other levels. The OAP procedures

would facilitate that process, would reduce time now lost in getting the right people to focus on the problem at the same time, and would result in more effective use of recruiting resources and incentives.

OAP introduces the concepts of banking resources and drawing ahead on resources as required. The OAP plan would be part of the PPBS process as discussed above. It would be part of the plan. It would be triggered under preagreed conditions and would function within the PPBSAA processes. OAP would have considerable flexibility. It could vary from year to year and from Service to Service. Each Service would propose an OAP as part of its POM. The OAPs would be reviewed at each level in the budget cycle and issues would be resolved until the final OAP would become part of the Administration's spending plan. As long as the budget assumptions held, the recruiting plan would be in effect. When preagreed limits were exceeded (recruiting conditions were either better or worse than assumed), the OAP reviews would begin.

Although the specific OAP addressed here is only one of several possible choices and probably would grow and change during prototype development and system implementation, at least some aspects of the OAP are needed to overcome the resource delay problem.

Pros:

a. An OPA type stimulant is needed to get near-term resource adjustments considered in a timely manner;

b. The regular budget cycle is not responsive enough without some offline process both to add and cut resources as conditions change; and
c. OAP would enhance efficiency by spending resources when needed and banking them when they are not needed.

Cons:

a. OAP could be used to cut as well as add resources;
b. OAP may result in gaming (Service underfund recruiting and ask for more resources each year);
c. Preagreement is a new concept that may be difficult to get approved; and
d. The preagreement process may slow the Defense authorization and appropriations process (that is already too slow).

The OAP is feasible if preagreement can be developed. OAP would change the Congressional oversight process. Clearly some improvements that would accomplish the objectives of the OAP are needed, but prototypes should be developed and simulations conducted involving those who will have to manage the system before final judgments should be made on feasibility and desirability.

5. <u>Immediate Crisis Avoidance Authority (ICAA)</u>

The ICAA was compared to the sprinkler system in our fire prevention analogy. The ICAA is intended to provide immediate resources and policy flexibility needed to avoid an immediate crisis while the deliberations of the

OAP are working on more substantive solutions. The ICAA involves near-term, emergency actions that can be taken by the Service if preagreed limits are exceeded. It is a "one-way" system. Only the OAP or budget processes would be used to reduce resources. The ICAA would only add authority when preagreed limits were exceeded.

As with the OAP, the ICAA would be part of the plan. It would be included in the PPBSAA process and would be reviewed and approved as a contingency during the regular budget cycle. Although additional authority provided would be triggered automatically, specific actions would be subject to management control at the Service or sub-Service level -- people, not computers, would control ICAA actions.

The ICAA is very attractive to the Army participants and is the part of the system they want most. The ICAA is potentially very flexible. It could provide very specific authority and resources or could be very general in nature. As with the OAP, it could vary dramatically from year to year and Service to Service. The Services would submit their proposed ICAA in their POMs. When recruiting conditions or forecasts exceeded preagreed limits, the Services would automatically be granted the additional authority provided in the ICAA conditions of the authorization and appropriation acts for that year.

Pros:

a. ICAA would provide authority where needed, when needed;

b. ICAA would continue to give Congress and the Administration control, but would provide for contingencies;

c. The ICAA would provide good insurance against an accession crisis;

d. The ICAA can be implemented without major changes in the PPBSAA system.

Cons:

a. ICAA may require more precise management than does the current system;

b. It is susceptible to gaming;

c. It may contribute to ratchet increases in standards and costs; and

d. The same preagreement concerns expressed in OAP may apply to ICAA.

The ICAA concept is feasible, if preagreement works. As with OAP, ICAA prototypes need to be developed and simulations run involving those who will operate the system. Feasibility and desirability should be reconsidered during prototype development and testing.

C. Comments by Participants

The following subsections summarize the specific comments of the various key participants in the discussion. No official Service positions were sought, and comments represent the personal views of the participants. These views should be considered as expressions of knowledgeable participants who have studied the concepts over a period of months, rather than expressions of the official views of any of the organizations mentioned.

1. Army

The Army participants were among the more enthusiastic about the ACPP concept. Perhaps the Army recruiting command and Army staff already are sensing that hard times are ahead and that the resources in existing programs and the budget year may not meet the Army's recruiting needs. The Army's Service Advisory Group (SAG) team presented numerous examples of how these concepts could be incorporated in their programs and budgets to avoid future problems. The Army SAG participants believed in March that the Army already was in an accession depression and that an alert and warning already would have been sounded if the system were in effect.

A former senior Army official was especially intrigued by the Immediate Crisis Avoidance Authority that would encourage (if not demand) action when planned recruiting conditions did not materialize. At the same time, he was concerned with the implementations that waivers to standards might impose in lieu of additional resources. The Army participants raised no concerns that would question feasibility of the ACPP concept.

2. Navy

The Navy SAG team was very helpful during discussions of the ACPP concepts. Although the members emphasized that they were speaking for themselves and did not have Departmental approved positions, they supported the ACPP concepts. Because the internal Navy resource allocation process seems to be more reluctant to fund

recruiting contingencies than are those of the other Services, the team believed that the EEWS and the ACPP would help the Navy Recruiting Command obtain needed recruiting resources.

The SAG team expressed some concern that the Navy might delay committing recruiting resources until it had a serious problem, if it could easily reprogram resources at a later time. The availability of such an escape mechanism might lead to further budget cuts. After all, if funds can be added if needed, why commit them in an environment of resource scarcity and enormous demands for procurement, shipbuilding, logistics, and other people programs.

The Navy team believed that the ACPP would help it meet its requirements if the recruiting market suddenly tightened.

3. Air Force

Again, as with the other Services, the cooperation of the Air Force SAG team at the accession workshop was extremely valuable. The insight that the team (with both officer and enlisted representation) provided to the research was invaluable. A comprehensive discussion of the concept and the Air Force recruiting system yielded good understanding on both sides.

The Air Force team questioned the need for systemic changes. The Air Force team suggested that its current system forecasts changes in recruiting conditions and makes needed adjustments in resources without an

elaborate coordinating mechanism. Various Air Force representatives expressed concern that Air Force recruiting could be hurt by outside restrictions on its program combined with special recruiting incentives provided to other Services.

The Air Force SAG team felt that the ACPP system should be shaped to meet the specific needs of each Service and that each Service should have control of the program that would affect it.

4. Marine Corps

The Marine Corps SAG team was not able to attend the workshops, but a separate meeting was held that included programmers and budgeteers, as well as recruiters. Some Marine Corps representatives strongly supported the ideas while others questioned the Corps' need for such a formal system. The Corps is relatively small and uses a much simpler management system than the other Services. It may not need a program as formal as the proposed ACPP, although the desirability of having more flexibility seemed to be generally supported.

The fact that the Offline Adjusting Process could reduce or redirect resources away from recruiting, as well as increase or redirect them toward recruiting, was raised as a matter of concern; but it was accepted as an inevitable part of any program that increases flexibility.

ENLISTMENT EARLY WARNING SYSTEM AND

ACCESSION CRISIS PREVENTION PROCESS: PHASE II WORK PLAN

I. OBJECTIVES

In Phase I of this project, the study team demonstrated the feasibility of developing an Enlistment Early Warning System (EEWS) and Accession Crisis Prevention Process (ACPP). For the EEWS, preliminary forecasting models were tested and validated, required data were shown to be available, and a conceptual design for the automated monitoring component was prepared. The concepts of the ACPP were explored and clarified, and a management design was developed.

In Phase II, an automated EEWS and an ACPP will move from the drawing board to become operational prototypes. Throughout this phase, we will continue furthur development of the forecasting models, the EEWS data base, and the ACPP management system.

II. TASKS

To accomplish the objectives of Phase II, the study team will undertake the following tasks:

Task I. Collect Additional Data

The EEWS data base will be expanded to include additional policy variables and district-level observations. It will be updated with data through December 1984.

Task II. Continue Model Development

Additional EEWS forecasting models will be tested, validated, and compared with those developed in Phase I.

UNITED STATES ARMED SERVICES AND OFFICE
FOR THE SECRETARY OF DEFENSE

ENLISTMENT EARLY WARNING SYSTEM AND ACCESSION CRISIS PREVENTION PROCESS

VOLUME VII PHASE II IMPLEMENTATION PLAN

JUNE 15, 1984

ECONOMIC RESEARCH LABORATORY INC.

Advanced Technology

SRA CORPORATION

3. The ACPP concept probably is feasible, but it will require acceptance by the Services, OSD, OMB and the Congressional Committees.

4. Phase II should be undertaken, prototypes developed and tested, then the issues of feasibility and desirability should be revisited.

The issue of feasibility should be reevaluated during these processes, and final decisions on feasibility should be deferred until phase II is completed.

C. Next Steps

Volume VII discusses in some detail the proposed next steps for phase II for the integrated EEWS and ACPP system. Here it is sufficient to note that phase II of the ACPP is designed to build on the current work and be fully integrated with the EEWS development.

Prototypes of potential POM submissions to incorporate the ACPP concepts will be developed and tested through simulations. During these simulations, concepts will be refined and various components of the system will be evaluated to see if they are worth the effort and the cost. Other variations on the basic concepts will be considered. The object of the simulations is to see how the EEWS and ACPP system would work with the additional insight gained from Phase II. The Services and OSD will be in a better position to decide what they want to implement.

D. Conclusions

1. There are bona fide problems of recognition lag and resource delay that could create accession crises when recruiting conditions deteriorate and waste resources when recruiting conditions improve.

2. The ACPP proposed here would significantly reduce the magnitude of the potential problems and significantly improve management in the Department of Defense.

labor market and is too sensitive to changes in economic conditions and in the recruiting environment to function well on resource levels set more than two years in advance and not subject to systemic adjustment during the near-term.

There also was general agreement that the perception of recruiting conditions often varied widely at different levels in the pyramid. Recognition of changing conditions begins with the field recruiter. By the time the change passes from the field recruiter through the recruiting commands, the Services, OSD, OMB, to the Congress, several months have elapsed.

During the feasibility analysis, there was general agreement that the problems of recognition lag and resource delay are valid and that the proposed processes would help solve the problem. Some participants expressed concern that preagreement, banking of resources, and the Offline Adjustment Process would not be acceptable to the OSD Comptroller or the Congressional Committees. Some participants questioned whether the problems were serious enough to warrant the effort and cost required by the solution.

In general, the concepts were supported and considered potentially feasible. As with many new ideas, change often is threatening, and no one can say for sure how the whole system will work after the changes are made. A consensus was generated, however, to move to phase II and develop prototypes of the EEWS and ACPP, build and use the EEWS models, structure prototype ACPP PPBS submissions, and simulate alerts and warnings using the various prototype procedures and committees to see how they would operate.

3. A Working Level Coordinating Committee that meets regularly and when a warning is issued by the EEWS's Human Assessment Group (generally composed of the same membership).

Although the SPRs may be considered a separate part of the process, they also would be integral to the OAP. The Senior Level Coordinating Committees would support the Performance Reviews and respond to recommendations of the Working Level Coordinating Committee. The Senior Level Committee would review the conditions leading to the alert and warning and would act on the recommendations of the Working Level Committee. It would provide feedback to the Services and would forward recommendations that require higher level approval. This process would provide an additional avenue for the Services to bring their recruiting proposals forward for consideration when conditions assumed in previous budget cycles do not materialize as planned.

The Working Level Coordinating Committee would meet regularly to keep the procedures in operation, and would meet as the Human Assessment Group of the EEWS to evaluate each alert and, after determining that a warning was appropriate, would develop specific recommendations for Offline Adjustments to recruiting policies and resources.

B. Feasibility

There was general acceptance among the members of the Service Advisory Group and others who participated in discussions of the proposed ACPP that the PPBS has more flexibility than it used to have, but that additional improvement is needed. Recruiting is too dependent on the

The PPBSAA would provide legitimacy to the other processes. The concept preserves the roles of the Services, OSD, OMB, and the Congress in the resource allocation process. Throughout the PPBSAA process, the assumed recruiting conditions should be directly linked to the recruiting resources. Finally, the FYDP, the Service POMs, the President's Budget, the Congressinal authorization and appropriations, the resulting Service spending plans, and daily operations should include the specific conditions under which the offline adjustment and additional authority would be triggered.

The EEWS and ACPP processes themselves would help improve communications. Key information on current recruiting conditions, forecasts of near-term conditions (6 to 7 months in advance), and changes in leading indicators need to be rapidly disseminated to all levels in the decision process. Improved communications would help avoid masking problems until they become crises, would increase the credibility of Service requests at higher levels, would facilitate reprogramming and supplemental appropriations, and would be essential for the other parts of the ACPP to work effectively.

The Offline Adjustment Process would involve three levels of interaction:

1. Semiannual Secretrial Performance Reviews (Spring and Fall),

2. A Senior Level Coordinating Committee that meets as needed, and

The EEWS and ACPP proposed here are fully integrated and would work closely together. In fact, the concept uses the same people to serve on the EEWS's Human Assessment Group and the ACPP's Working Level Committee. This arrangement ensures that those who decide there is a problem also help develop the solution.

The ACPP would use a five part approach that would build on the current recruiting and resource allocation organizational structures, would retain most of the existing procedures, and would take full advantage of the new EEWS. The five parts are:

1. Holding regular Manpower Secretarial Progress Reviews,

2. Modifying the PPBS-Authorization-Appropriation (PPBSAA) Processes,

3. Improving Interlevel Communications,

4. Developing an Offline Adjustment Process, and

5. Developing an Immediate Crisis Avoidance Authority (ICAA).

The Secretarial Performance Reviews would meet at the pleasure of the Secretary of Defense at the recommendation of the Assistant Secretary for Manpower, Installations, and Logistics. The Spring SPRs probably would focus on the accession programs, and the Fall SPRs on the incentive programs (especially the annual pay raise assumptions).

CHAPTER V

SUMMARY AND CONCLUSIONS

A. Summary

The past 15 years are a history of cyclical swings between excessive recruiting resources and accession crises. Poor interlevel communications and inherent delays in the programming and budgeting cycle have aggravated the problems. During periods of poor recruiting, resources were increased; but those increases did not take effect until after conditions improved. Resource restrictions imposed during periods of good recruiting usually took effect after conditions deteriorated. Recogniti.n lag and resource delays have been and continue to be serious problems calling for systemic improvements.

The Enlistment Early Warning System (EEWS) discussed in volumes II and IV and the Accession Crisis Prevention Process (ACPP) discussed in the previous chapters of this volume are integrated and depend upon each other for success. To take advantage of an effective early warning requires a responsive resource allocation process. Without that process the EEWS is of little value. Conversely, to be effective, an ACPP needs to have reliable and accurate indicators of accession conditions to trigger its review and avoidance procedures. To the extent possible those indicators should forecast changes in conditions sufficiently early to permit policy and resource adjustments to take effect before crisis conditions develop.

E. Conclusions

1. There are bona fide problems of recognition lag and resource delay that could create accession crises when recruiting conditions deteriorate and waste resources when recruiting conditions improve.

2. The ACPP proposed here would significantly reduce the magnitude of the potential problems and significantly improve management in the Department of Defense.

3. The ACPP concept probably is feasible; but to work it will require acceptance by the Services, OSD, OMB, and the Congressional Committees.

4. Phase II should be undertaken and prototypes developed and tested, then the issues of feasibility and desirability should be revisited.

sure the concepts are well understood and any avoidable problems are resolved before the Administration formally considers the concept and specific details become firm and non-negotiable.

D. Legal

The study team has identified no legal obstacles to implementing the concept. It could be included under the general management provisions that empower the Secretary of Defense to manage the Department. Specific authorization and appropriations language restrictions are part of annual authorization and appropriations committee reports and bills. If Defense is successful in advancing the ACPP concepts, the appropriate language could be included in Congressional documents to incorporate the new ideas.

At this point the concepts have not been submitted to the General Counsel for formal opinion or informal comment. Although the nature of this proposal is not particularly complex, the General Counsel's office needs to be included in the analysis early in phase II. The Office of the General Counsel works closely with the Congressional staffs, and its support would be important to selling the ideas to those staffs.

The General Counsel's office usually has substantive insights that contribute to studies of this nature. It is not anticipated at this point that there will be any legal obstacles to ACPP implementation.

At the staff level, OMB was willing to serve on the Working Committee, but would not be offended if Defense chose to invite them on an as appropriate basis or not invite them at all but keep them informed of changes in forecasts, leading indicators, and actions being contemplated. The study team believes that the long-range effectiveness of the concept requires close cooperation by all those who must participate in the Offline Adjustment Process and would strongly recommend that the OMB staff participate on the Study Advisory Group during the development phase of this contract and be included as an integral part of the ACPP committees.

7. Congressional Committees

The Congressional staff has been the party least consulted so far in this study. That is appropriate, because this is an Administration proposal that still is in the conceptual stage. In brief general discussions, the ideas of conditional flexibility were not opposed. No one suggested that Congressional members or staff should sit on any of the committees. The study team considers that the division of government would preclude any such direct participation; but Congressional oversight of preagreed conditions, the incorporation of recruiting assumptions in budgets, and including conditions under which offline reviews and additional authority would be triggered are appropriate Congressional roles in the ACPP process.

At the general concept level, the idea was not rejected, and no insurmountable objections were raised. Phase II of the study should include more direct contact with the Congressional staff and selected members to be

Representatives from the office of the OSD Comptroller were perhaps the most cautious of the OSD participants. Concerns were expressed that Congress would not accept preagreements. The Comptroller's representative was very concerned about the banking concepts and the Offline Adjustment Process. The problem was accepted as real, and the need for innovative solutions was recognized. Improved interlevel communications was strongly supported, and ideas for better documentation of the PPBS and spending plan assumptions (at least within DoD) were considered "worth trying."

The comments of the Comptroller's staff raised feasibility issues that led the study team to place conditional judgments on the feasibility of the ACPP. Perhaps only part of the concept can be implemented. The Comptroller's support is essential for an effective ACPP to be developed. Consensus was reached that phase II should be undertaken and prototypes developed and tested, and then the feasibility issue should be revisited.

6. Office of Management and Budget

In response to general discussions about the concept, the OMB staff was supportive. Staff members expressed concern that the project was not moving forward fast enough. To be effective, the concept needs to be implemented during this Administration in order to be in place before the economic recovery creates embarrassing recruiting problems.

The Marine Corps representatives concluded that they generally support the concepts that were espoused, but would want to think more about the details before endorsing any specific plan. No issues were raised that would indicate that the concepts were considered infeasible, but perhaps some concern that they might work as well as the proponents hope.

5. Office of the Secretary of Defense

The Deputy Assistant Secretary for Manpower Planning and Force Management endorsed the concept and arranged for briefings and discussions with other key members of the Secretary's staff. The Accession Policy staff has worked directly with the contractors in the development of the concepts in these volumes and expect to use the resulting analysis. Neither the DASD nor his staff have advanced any problems that would challenge the feasibility of the ACPP concept.

The Director of Program Analysis and Evaluation was enthusiastic about the concept and recommended implementation in September 1984. He suggested incorporating regular Secretarial Performance Reviews as an integral part of the concept and raised the idea of including a wedge in future year appropriations as conditional funding similar to the buffer fund for foreign currency exchange. Some members of the PA&E staff questioned the willingness of the budget staffs to incorporate assumptions with the recruiting budgets, because such assumptions would limit the flexibility of budget managers to adjust resources to meet imposed budget ceilings.

Task III. <u>Track the Recruiting Market</u>

The prototype EEWS will be used to track and forecast enlistments and recruiting market conditions.

Task IV. <u>Develop ACPP Prototypes to Support POM Submissions</u>

With recruiting and program-budget personnel from the Services, the study team will develop ACPP prototypes that will support the Services' current POM submissions.

Task V. <u>Develop Procedures for Reviewing Recruiting Market Condition Assumptions Used in POM Submissions</u>

With the OSD staff, the study team will develop a prototype review of the Task IV products as well as inputs for the Five Year Defense Plan (FYDP) and the Defense Budget. (This task includes developing language for the President's budget that could be included in the Congressional Authorization and Appropriations Bill.)

Task VI. <u>Develop the Human Assessment Group</u>

The study team will develop a prototype agenda for a Human Assessment Group meeting and adapt it to Service requirements during a simulation using EEWS forecasts and supporting data.

Task VII. <u>Develop and Test the Offline Adjustment Process (OAP) and Immediate Crisis Avoidance Authority (ICAA)</u>

With personnel from the OSD staff and the Services, the study team will develop prototypes for the OAP and ICAA to include improved inter-level communications. The prototypes will be tested and refined by using them in a simulated alert. (The simulation will include active participation by the Human Assessment Group and the two Offline

Adjustment Committees.)

Task VIII. Prepare Presentations for Secretarial Performance Review

With the OSD staff, the study team will prepare a briefing of the EEWS and ACPP suitable for presentation at a Secretarial Performance Review.

Task IX. Install An Interim Automated Enlistment Early Warning System

The study team will install an interim batch system that generates timely and useful information on enlistments and recruiting market conditions.

Task X. Identify and Document Detailed System Requirements for an Automated EEWS-Decision Support System (DSS)

Through extensive interviews with the users and examination of system sites, system requirements for the automated EEWS-DSS will be identified and documented in detail.

Task IX. Develop Baseline Specifications

From the system requirements document, the study team will develop baseline specifications and designs for an on-line EEWS-DSS, document these,and provide to the user.

Task XI. Prepare Briefings and Reports

The study team will prepare briefings, monthly progress reports, and a final report of the results of the study.

III. DISCUSSION OF TASKS

Task I. Collect Additional Data

Step 1. Collect National-Level Data

National-level data provided by the Services and OSD will be collected on leads, advertising expenditures, DEP attrition, DEP stock, retention, and, perhaps most importantly, recruiting policy changes. These data will be used to increase the accuracy of enlistment forecasting models. They also will be of value to both the Human Assessment Group and the ACPP committees in making decisions and recommendations.

Step 2. Update Data in Current Models Through December 1984

Certain models estimated in Phase I (reported in Volume IV) will be selected for monitoring the recruiting market. In Phase II, we will update the variables in these models to include observations through December 1984. National-level data collected in this task will be used for further development of the forecasting models.

Step 3. Update EEWS Data Base Through December 1984

We will develop further, then test and streamline updating procedures by undertaking each month to update the national-level data base. We will continue this process until the database includes observations through December 1984.

Step 4. Collect District-Level Data

For each Military Service, we will collect regional-level monthly data for the period October 1978 - December 1983. The regions will correspond to the recruiting district-level boundaries of each Service in FY 1983. The data base will include gross

contracts for high school diploma graduates (HSDG's) and seniors (HSSR's), unemployment, civilian earnings, recruiters, advertising, leads, and goals. These data will be obtained from the Defense Manpower Data Center (DMDC), the Bureau of Labor Statistics (BLS), the Services, OSD, and Princeton University's Census data-processing center.

Step 5. Process National and Regional-Level Data

The data collected in Steps 1-4 of this task will be processed to yield variables useful for analysis and forecasting. These will be merged with the EEWS working data base at Boeing Computer Center for model development and forecasting.

Task II. Continue Model Development

Step 1. Improve National-Level Models

In Phase I we found that monitoring alerts and "outliers" were caused largely by policy changes which were not included in the model. In this task we will improve the model by adding new variables measuring policy/program changes.

a. Better Specifications and Data

Models will be expanded to include the previously omitted policy variables and they will be estimated. In addition we will consider alternative specifications and estimation methods that were not tried in Phase I, e.g., certain types of distributed lag models and maximum likelihood estimation procedures.

b. Two-Equation Recursive Model: Applicants and Contracts

Good applicant data, made available late in Phase I, will

allow us to model the enlistment pipeline. We will construct a two-equation recursive model in which applicants are a function of explanatory variables, and contracts, in turn, depend on lagged applicants and other factors. This approach may allow us to extend the forecasting horizon beyond the current range of eight or nine months.

c. Time-Series Models and Composite Forecasts

In general, regression models seem more promising than time-series approaches for forecasting enlistments. But in Phase I a time-series model did out-perform the regression model in selected forecasting tests. As a result, we will update a time-series model - the univariate - and combine forecasts from the two types of models to yield a composite forecast (see also Task II, Step 3). The accuracy of the composite forecast will be compared to others using forecasting tests.

Step 2. Estimate District-Level Models

The Service-specific, time-series, cross-section data bases developed in Task I, Step 4 will be used to estimate district-level forecasting models. Districts will be modeled separately, with time series data, and as one, by pooling data among districts.

As in Phase I, estimation will be carried out with data for the period October 1979 - March 1983, while forecasting tests will use data for April 1983 - December 1983. The results will be compared with those results obtained in Phase I to determine whether use of district-level data increases forecasting accuracy or reduces forecasting confidence intervals.

Step 3. Explore Alternative Unemployment Models

a. Leading Indicator Models

Only a few leading indicator models were estimated in Phase I. These fit the data very well in the regression period, but they generate poor forecasts. We believe that further study might be fruitful, so alternative leading indicator models will be investigated in Phase II.

b. Composite Forecasts

The combining of forecasts from alternative models and sources may reduce biases intrinsic in a single methodology. We will explore this approach by generating composite forecasts from the univariate and leading indicator models, as well as from outside sources, e.g., Georgia State University, Bureau of Economic Analysis, Congressional Budget Office, etc.

c. Kalman Filters

We will seek to improve the forecasting accuracy of unemployment models by using the Kalman Filter estimation methodology. This "self-correcting" approach gives greater weight in the estimation period to recent prediction errors. As a result, it should reduce the likelihood of a recent shock causing a series of errors throughout the forecast period.

As in Phase I, the various models developed in Task II, Step 3 will be validated and compared using forecasting tests for a common period (April - December 1983).

Task III. Track The Recruiting Market

During Phase II, we will track and forecast enlistments and

unemployment rates on a monthly basis using the models previously developed and validated in Phase I. (In Task IX our capability will be augmented through the installation of a "batch system" at Boeing Computer Services.

Task IV. Develop ACPP Prototypes to Support POM Submissions

The ACPP was developed to reduce the time required for the various management levels to recognize changing recruiting conditions and to marshall the resources needed to respond to these changes. The study team identified five specific means by which the objectives may be accomplished. The ACPP would: 1) provide for regular Secretarial Performance Reviews, 2) modify the PPBS-Authorization process, 3) improve inter-level communications, 4) develop an Offline Adjustment Process, and 5) develop an Immediate Crisis Avoidance Authority. This task focuses on item 2. We will work with the Military Services to develop ACPP prototypes that are compatible with the recruiting programs proposed in the POMs of the participating Services. The result would illustrate the Service inputs to the PPBS process.

Step 1. Provide Documentation of Recruiting Market Conditions For POM Submissions

The study team will work with the Services' program-budget personnel and recruiting command staffs to develop standard assumptions regarding recruiting market conditions. These assumptions will be made explicit and will be phrased so that they can be included in the Services' POM submissions and carried forward through the entire PBBS authorization, appropriation, and spending processes. The market condition assumptions will include:

a. Planned non-prior-service (NPS) accession profiles (male and female by quantity and quality),

b. Delayed Entry Program (DEP) levels needed over time to support

the accession period,

c. Time-phased contract levels needed to support the DEP,

d. Enlistment leads needed to generate contract levels,

e. Recruiting resource levels (including Service-specific advertising, joint advertising, recruiter levels, recruiting support costs, enlistment incentives, etc.) needed to generate planned levels of contracts,

f. Levels of entry pay and benefits, and

g. Economic conditions (especially unemployment) used to size the pay levels and recruiting resources.

Step 2. Establish Standardized Assumptions

The prototype ACPP will include recommendations for the following:

a. Trigger points (both upper and lower limits for selected assumptions) to initiate the Offline Adjustment Process review of assumed recruiting resource levels, and

b. Trigger points (lower limits for selected assumptions) to initiate the Immediate Crisis Avoidance Authority and the additonal authorities to be provided.

Task V. Develop Procedures For Reviewing Recruiting Market Condition Assumptions Used in POM Submissions

Included in the ACPP concepts developed in Phase I were procedures for OSD review of the Services' ACPP POM submissions and for the development of issues concerning resources to be available, should

preagreed limits be exceeded. In reviewing the trigger points proposed by the Services, the OSD staff would begin the process of agreeing on conditions for activation of the Offline Adjustment and Immediate Crisis Avoidance Authority. By including the Service inputs, the proposed DOD Budget brings them to the attention of OMB, hopefully for further review and concurrence. The same procedure is continued through the Congressional Authorization and Appropriations processes.

Step 1. Develop Prototype Review by OSD

During Phase II we will work in conjunction with the OSD staff to develop a prototype review of the Task IV products and a prototype input for the FYDP and the Defense Budget.

Step 2. Develop EEWS and ACPP Explanations for Budget Authorities

We will develop sample language for the President's budget that makes a case for the EEWS and ACPP programs. It also would include sample language that could be used in the Congressional Authorization and Appropriation Bills to elicit congressional approval of the ACPP provisions, establish legitimacy for the trigger points, and permit reprogramming (and perhaps additional spending if certain recruiting conditions occur). This constitutes the final stage in the preagreement process.

Task VI. Develop the Human Assessment Group Functions

In Phase I we outlined the role of the Human Assessment Group and how it might operate in case of an alert. We identified tasks to be accomplished by the Group and developed a report format for summarizing the Group's findings. In Phase II we will further develop these designs, organize an operational prototype of the Human Assessment Group, and test its ability to function.

To do this we propose that a working-level Human Assessment Group be

staffed by the SAG. Furthermore, we propose that it meet during the project to provide an assessment of the recruiting market using the EEWS forecasts and supporting information. These meetings will yield useful guidelines for the staffing, organization and operation of the assessment groups.

Task VII. Develop and Test the OAP and ICAA

In Phase I, we developed feasible concepts for an EEWS, Offline Adjustment Process and Immediate Crisis Avoidance Authority that would enhance inter-level communications, reduce recognition lags, and accelerate resource reallocation processes to prevent accession crises. In this task we will develop these concepts further.

Step 1. Design OAP and ICAA Prototypes

In Phase II we will work with the OSD staff and the participating Services to design prototypes of the OAP and ICAA systems, laying out how they should work for each Service.

Step 2. Test Systems Responses

Having established prototypes for these procedures and for the PPBS and congressional processes, we will conduct simulations of various changes in recruiting conditions to test how the systems would respond. These simulations should include active participation by the Human Assessment Group and the two Offline Adjustment Committees.

Additional simulations and further testing could be included in later phases to help work out implementation details and evaluate potential system improvements. The EEWS and ACPP could be exercised on a regular basis by the Services or the Department of Defense, just as is done with mobilization plans. Task VII is intended to continue feasibility testing from Phase I and begin what likely

would become a regular series of "what-if" simulations to refine the procedures, improve communications, and fine-tune the system.

Task VIII. Prepare Presentations for Secretarial Performance Review

In Phase I of the study we explored the advisability of making manpower a regular part of the Secretarial Performance Review with compensation, recruiting, and other manpower issues being considered at appropriate times in the Defense management cycle. An effective EEWS and ACPP would significantly enhance the ability of the Services to achieve recruiting objectives through both good and bad economic times. Therefore, the prototype development and testing of these systems is a propitious subject for Secretarial Review, for congressional testimony, or for other high-level forums.

With the OSD staff we will prepare a briefing suitable for such presentations. It will include the concepts developed in Phase I and the prototypes and tests of Phase II. The resulting script and graphs would be part of the Phase II final report.

Task IX: Install An Interim Automated Enlistment Early Warning System (EEWS)

In Phase I the study team developed a conceptual design for an automated EEWS Decision Support System (EEWS-DSS). In Phase II the automated system will be developed using the classical DSS design approach. Development will proceed in iterative stages, incorporating feedback from the users during the previous stages, and revising the design of the system to accomodate any changes in user requirements. The plan for automating the EEWS calls first for a batch processing system that will provide interim service to users during the design (see Task X) and implementation of the more sophisticated system. The interim system will allow the users to become familiar with the system's outputs and to identify additional required capabilities -- if any -- that might be installed in the EEWS-DSS.

Step 1. Integrate Existing EEWS Models

In Phase I we developed a set of models for forecasting and monitoring enlistments. In Phase II, models will be selected and integrated into a batch processing environment to provide EEWS reports.

Step 2. Develop Report Generation Software

This step consists of designing, programing, and installing software to produce the set of standard reports required by the EEWS. Graphical reports will be generated using SAS software. Because the first step involves implementation of an interim system, minimal system documentation will be provided. The documentation will include instructions for producing standard reports and updating the data base, as well as for correcting unforseen system processing errors.

Task X. Identify and Document Detailed System Requirements for an Automated EEWS-DSS

In Phase I, general user requirements were identified and a conceptual design developed for an automated EEWS-DSS. Detailed requirements could not be identified because 1) a specific host site had not been selected for implementation of the automated EEWS-DSS; 2) user site locations and associated terminal/communication equipment available at these sites had not been specified; and 3) potential users had not identified specific desired outputs or processing capabilities to be included in the system. Therefore, to establish a sound foundation for preparation of the baseline specifications for an on-line system, a detailed requirements study will be performed and the results of this study documented.

Step 1. Identify Existing Hardware/Software Environment and Associated Requirements

Based on the host processing site selected by the SAG and the access sites identified by users, we will obtain the appropriate information and identify hardware/software requirements and constraints that will be imposed on the system. This will establish a basis for the necessary evaluation of the capabilities desired by users.

Step 2. Identify Specific User Required/Desired Capabilities

This step will include meetings with individual users to identify specific information required and the formats of associated reports. Also we will identify desired system processing capabilities, as well as desired capabilities for generating output in varying formats. These capabilities will be evaluated against any constraints identified in Step 1.

Step 3. Identify Required Information Flow Structure

Based on the requirements identified in the first two steps, we will determine the information required to generate required/desired system outputs. This will include information necessary to support the system's processing tasks. Then we will determine all specific input needed to support the system, and identify requirements for updating information and maintaining security. Finally, system information flow requirements will be developed from the total information package.

Step 4. Document Requirement Study Results

Based on the results of the first three steps, the requirements to be supported by the detailed system design will be documented and provided to the user in a final form.

Task XI. Develop Baseline Specifications for an Automated EEWS-DSS

The next stage of the iterative development process for the automated EEWS is the development and implementation of an on-line DSS. This task will provide the baseline specifications for the system. To accomplish this task, we will apply structured design techniques to develop detailed specifications for an automated EEWS-DSS. The system will be designed for an on-line environment at a centrally-located processing site, using data bases located at different sites. The system design will be developed around a Tower Architecture and will include three different components: Dialog, Modeling, and Database. The specifications then will be documented to serve as the baseline for the automated EEWS-DSS development and implementation process. Using the specification document, we will prepare schedule and cost estimates fo: the system's development and implementation.

Step 1. Prepare Detailed Functional Specifications

Using structured system design techniques, we will document all functions necessary for the processing of forecasting algorithms and monthly EEWS reports.

Step 2. Prepare Detailed System Design Specifications

Using top-down methodologies, we will segregate the required functions into modular components, and design necessary programs, routines, and subroutines. Standard functions will be listed in program sequence, and unique algorithms will be written in pseudocode.

Step 3. Conduct Design Walk-Throughs

We will meet with the users and conduct a walk-through of the detailed design. This will include a description of the functions

and how they will be performed, as well as descriptions of input and output, and how they will appear to the user.

Step 4. Make Any Necessary Revisions

Functional and system design specifications will be revised, as necessary, based on the results of the user design walk-throughs.

Step 5. Document Baseline Specifications

The detailed functional and system design specifications will be documented in draft form for user review. Upon review and approval, the specifications will be documented in final form and will serve as the baseline for development and implementation of an automated EEWS-DSS.

Step 6. Prepare Schedule and Cost Estimates

Based on the baseline document, we will prepare schedule and cost estimates for the development and implementation of the automated system. The estimates will be provided to the user in final form.

Task XII. Prepare Reports and Briefing

A draft report documenting results will be prepared and submitted upon completion of the tasks listed above. A final report will be submitted following review by the Study Advisory Group. In addition, monthly progress reports will be submitted to the Contracting Officer. We expect to meet with the SAG twice during the course of the project. A final briefing will be given to the SAG at the end of the project.

IV. SCHEDULE AND DELIVERABLES

We envision Phase II of the EEWS and ACPP study being accomplished in three parts. The tasks to be included in each part are listed below:

Part I:

Task I, Steps 1-4
Task III
Task IV
Task IX
Task X

Part II:

Task I, Step 5
Task II, Step 1 (a and b)
Task III (continued)
Task V
Task XI, Steps 1-3

Part III:

Task II, Step 1 (c), Steps 2 and 3
Task III (continued)
Task VI
Task VII
Task VIII
Task XI, Steps 4-6

Assuming an August 1, 1984 start date, Part I would be completed September 30; Part II would be completed November 30; and Part III would be completed March 31. We will conduct a briefing at the end of each of the Parts. Progress reports will be submitted each month of Phase II. A draft report will be submitted March 31, and upon review, a final report will be submitted on May 15, 1985.

END

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